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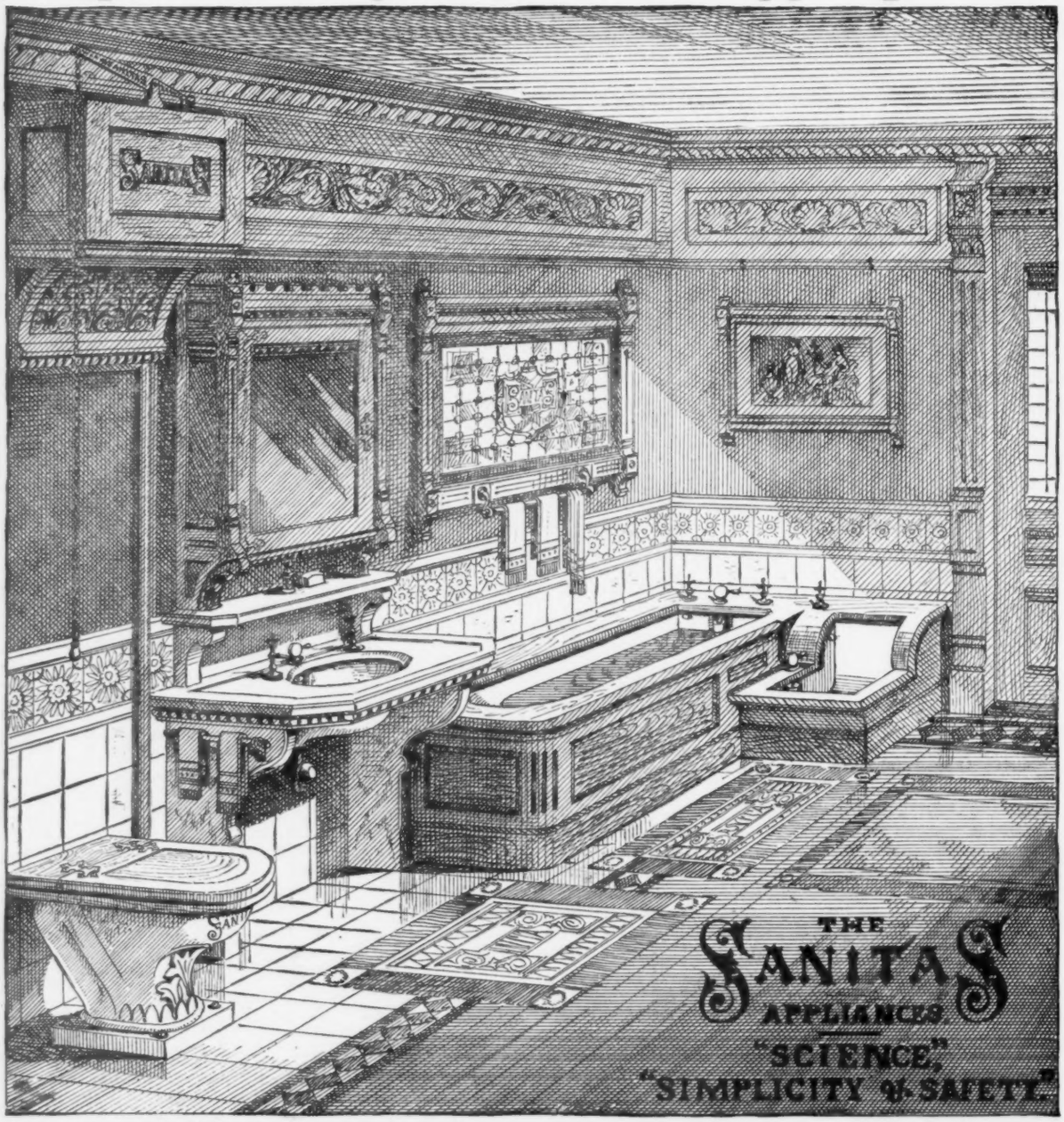
VIEW OF BATH-ROOM FITTED UP WITH THE

SANITAS ❁ PLUMBING ❁ APPLIANCES



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THE week has produced some curious incidents in trade-union matters, but, happily, none of a serious character. In one case, in Middletown, N. Y., a Mr. Smart undertook to build a factory, and hired bricklayers and masons. A part of the work consisted in the construction of melting furnaces for glass, and Mr. Smart, being thoroughly familiar with the proper mode of laying the fire-brick around such furnaces, and wishing to have this important part of the masonry done in the particular manner that he preferred, took up a trowel and began to lay a few bricks. Immediately an uproar arose among the masons and bricklayers, who informed their employer that they would not work with a "scab," meaning himself, and threatened to strike in a body unless he laid down his trowel at once. In the other case, a walking delegate of the Carpenters' and Joiners' Union was brought into court in New York, charged with having deprived Robert Hoff, a journeyman, of work. It appeared that Hoff had belonged to the Union, but had for some reason incurred a fine, which he refused to pay. He was thereupon expelled from the Union, and the walking delegate were set upon his track to persecute him. He was at work in a large shop in Twenty-eighth Street, where the delegate found him, and his employer was notified to discharge him, under pain of having all the rest of his men called out if he refused. He resisted for some days, but was at last compelled to ask Hoff to give up his work until the matter could be adjusted; and Hoff thereupon entered a complaint against the delegate. The case was called before Judge Gorman, who explained the law of New York to be that a walking delegate had no right to go to an employer and threaten to deprive him of his men unless he would discharge a particular workman, although the delegate had, as he said, "a perfect right to go among the men belonging to his Union, and arrange with them to stop work." Even this liberal privilege did not, however, appear to satisfy the delegate and his counsel, who will probably appeal to a higher court. We hope that the superior tribunal will still further abridge the activity of walking delegates, by setting some limit to the arguments which they may use in reasoning with their men on the subject of particular "scabs." If it is illegal and criminal to coerce an employer to dismiss an obnoxious person by threatening him with the loss of his other men, we cannot see how it is any less so to procure the same result indirectly by forcing the Union men to threaten their employer with the loss of their services. The real wrong is in the persecution, not in the technical process of carrying it on, and the law which is so careful of people's interests that it will not allow even true stories about them to be circulated to their detriment ought to be able to find some way of preventing an emissary from a secret and irresponsible tribunal from following a man about, and conspiring with his fellow workmen, whatever their affiliations, to deprive him of his living.

AN International Exhibition of Science and Industry is to be held next year in Brussels, and we are requested to communicate to our readers an invitation to take part, especially in that section which is to be devoted to engineering, architecture, and materials of construction. For each section a list of subjects to which it is intended to pay particular attention is furnished, and the list in the section of architecture presents problems of unusual interest. As might be expected from a Belgian Committee, the first set of problems offered is devoted to workingmen's houses, and contains in itself some excellent suggestions. The list begins with a programme for a group of industrial dwellings of various kinds, comprising houses for foremen, overseers and ordinary workmen, arranged with the idea of bringing these classes of persons into frequent and friendly contact. Beyond this point the details of plan are left to the designer, the directions stipulating only that the houses shall be arranged with strict economy, so that the rents may be low; and that an effort shall be made to give the groups a picturesque and cheerful air, so as to avoid the impression of dismal monotony presented by most collections of houses built for workingmen's use. The next problem deals with lodgings for unmarried workingmen in large cities, and the design is to present plans for a large house, to be divided into rooms arranged for this purpose; and the third calls for a somewhat similar structure, for the temporary accommodation of men whose families live in the country, but whose work calls them to the city for days or weeks at a time. This last, which is to us a novel problem in social science, seems to be particularly interesting and useful. With us, particularly, where city rents are enormously high, as compared with those abroad, while small lots of land in the country, and materials for building, are extremely cheap, the provision of clean, comfortable lodgings at twenty-five cents a day, which would be a fairly remunerative price, would enable many thousands of sensible and prudent men to establish their families in little houses of their own, in the pure air, and among the sweet surroundings of the country, and at the same time live themselves near their work during the business week, at a total cost which would not exceed that of a miserable, filthy tenement in the city; while, if work should fail for a time, the country cottage would always be ready, with no rent to pay, and the opportunity for utilizing the unexpected leisure in cultivating the little garden, and so providing subsistence for the family until better times.

THE next problem proposed for architects to solve is not entirely new, but has, of late, come very much into prominence. Several of the best-informed authorities, and, among others, one of the celebrated Siemens Brothers, have expressed their opinion that modern industry was tending by degrees to the breaking-up of the factory system, and the establishment of small workshops, carried on by one or two persons, or by the members of a family in a room of a private house. So far as can now be predicted, this substitution of small shops for factories will improve the condition of those who work in them, and the tendency is to be encouraged; and the managers of the Brussels Exhibition invite plans for houses adapted to the use of what they called "room workmen," (*ouvriers en chambre*), including, as matters of special detail, the study of methods of introducing motive power, derived, where possible, from some general supply of compressed or exhausted air, water under pressure, or similar sources of energy; together with analogous methods for producing and distributing among the little workshops and houses in the most economical way, light and heat. To all appearances, this very problem is destined to be one of the most important practical subjects of study of the future; and there is a good deal of credit to be obtained by a successful solution of it. Still more problems of working-people's houses are proposed, relating to dwellings of fifteen to twenty-five feet frontage, such as are built for such occupants, but with the requirement that they shall be picturesque and comfortable, as well as economical; and, finally, plans are invited for small hospitals, for "crèches" or public nurseries, for a small orphan asylum, for a convalescent hospital for children, and several other establishments of the kind; as well as for a railway station, a music hall, and a crematory. We do not learn from the communication sent us just when the Exhibition is to open, but further particulars can, without doubt, be obtained by addressing the Comité Exécutif, 22 Rue de Palais, Brussels, Belgium.

AN important industry has sprung up within a few years abroad in the manufacture of roof-tiles, made in various patented shapes in a machine, which moulds them with interlocking edges, so that they make a perfectly tight roof, with

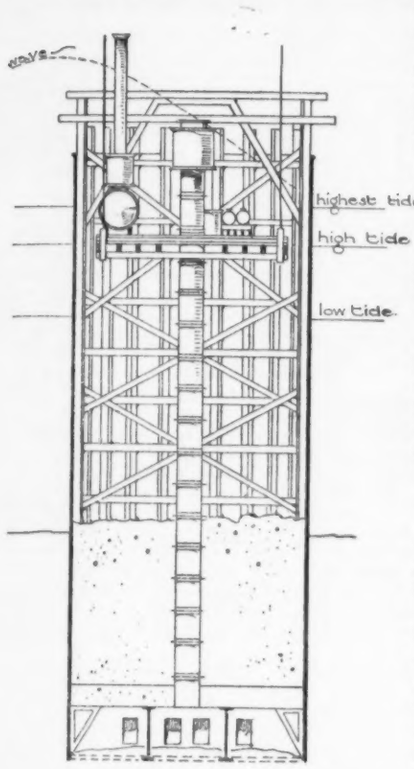
a lap of one tile over the next of less than an inch, in place of the six inches or so necessary with the ordinary pattern. A roofing-tile of this type, the Akron Diamond Tile, is manufactured in Ohio, but we know of nothing else of the sort made in this country. In our experience, the Akron tiles, although beautifully made, and of excellent material, are thin, and rather apt to break across if too tightly nailed, or shaken by the wind, leaving a bad leak in the roof; while the French and German tiles of the kind are now not only made large and heavy, but are reinforced in the middle, the thickness varying from three-eighths of an inch near the edges to more than an inch in the middle, so that transverse fracture is hardly possible. When properly glazed, such tiles are very durable and cheap, the cost of one of the best French patterns being considerably less than three cents per square foot, and they are not only used very generally at home, but are exported in immense quantities, more than two hundred million, valued in the invoices at about four and one-quarter million dollars, having been sent out last year from the port of Marseilles alone. When used in the place where they are manufactured, it is very common, instead of glazing them, either with a "slip" or a vitrifiable glaze, to dip the cheaper qualities, after heating them, in melted tar. This coats them with a black varnish, which penetrates into the pores, and makes them thoroughly waterproof at small expense. Besides this tarry black, which appears everywhere on the roofs of cheap buildings on the Continent, we have seen tile-roofs in France whitewashed; and in Germany and Switzerland brilliant-colored glazes are used, often arranged in such a way as to cover the roof of a church or other large building with a lively pattern. We do not know how much more such things would cost here than in Strasburg or Lyons, but at two and one-half or three dollars a square they would form a much cheaper roof-covering than slate, and, judging from the claims made by their manufacturers, ought to be tighter and more durable. For buildings exposed to fire they are acknowledged to be far safer than slate, which cracks off when cinders fall upon it; and, from an artistic point of view, they offer a richness of color, and an air of solidity and comfort, which no other ordinary roofing material can approach. We must acknowledge that we can imagine more beautiful designs than those which are given to the reinforcing projections in the middle of the tiles by the manufacturers whose catalogues we have seen, but it may be reserved for some American to lead the way to a perfectly artistic treatment of the subject.

M. A. VERNEUIL has recently made a study of the chemical properties of the well-known luminous paint, and a paper prepared by him was read before one of the late meetings of the Academy of Sciences in Paris and is quoted in several foreign journals. The commercial luminous paint is a sulphide of calcium, made by treating with sulphur the lime obtained by burning shells of a certain species common on the English and French coast. These shells furnish a lime which, though nearly pure, produces a much more brilliant light than can be obtained from mineral lime under the same treatment. The difference in the results is usually explained by saying that the organic matter in the shells aids the phosphorescent effect, and the known phenomena of phosphorescence exhibited by the decomposing tissues of fish and animals, together with that of many living fishes, give a certain plausibility to the theory, but M. Verneuil, perhaps reflecting that the process of calcination would remove pretty thoroughly the traces of animal matter from the shells, preferred to test the matter by the light of science, and made a careful analysis of the shells before and after burning. This showed that in their natural state a hundred pounds of shells contained ninety-eight pounds of carbonate of lime, one pound of carbonate of soda, one ounce of common salt, one ounce of silica and other insoluble matters, and eleven ounces of organic matter, with a trace of phosphoric acid and a little magnesia. Neglecting the organic matter, which would in any case be burned away by calcination, M. Verneuil next mixed a pure mineral carbonate of lime, such as marble dust, with carbonate of soda and salt, in proportions imitated from those of the shell. On roasting the mixture, a substance was obtained which gave a beautiful blue phosphorescence, somewhat less bright than that produced from the shell lime. As the perfect mixture existing in natural substances is only incompletely imitated by artificial processes, it is often necessary, in reproducing such substances, to increase the quantity of the elements contained in small proportion to give them their due effect, and a new mixture was made, containing one hundred pounds of powdered carbonate of lime, made into a paste with water in which two pounds of carbonate of soda and two ounces of common salt had been dissolved. This mixture was heated to bright redness, and, on cooling, mixed with thirty pounds of sulphur and one-third of an ounce of sub-nitrate of bismuth dissolved in alcohol, and again calcined. The substance so obtained was quite as phosphorescent as the paint made from shell lime.

A SIMPLE apparatus has recently been used in France for preparing the ingredients of concrete, which might, we should suppose, be used in works on a large scale with considerable advantage. As described in a letter to *La Semaine des Constructeurs*, the apparatus, which seems to have been originally devised by a manufacturer of concrete sewer-pipes, consists of a cylinder of copper, about three feet in diameter, mounted on a hollow shaft, which is pierced with many holes. The cylinder is also pierced with holes of varying sizes, arranged in zones, and a helix of copper is set in the interior. By a simple mechanism, driven by water-power from a brook, the cylinder is made to revolve about once a minute, and at the same time water is forced under pressure into the hollow shaft. Earth from the gravel bank near which the machine is set up is then thrown by shovelfuls into the upper end of the cylinder. The interior screw drives the material forward, at the same time that it is washed by the water issuing from the hollow shaft. The holes in the upper part of the cylinder are the smallest, and the turning, shaking and washing of the earth sifts out there the finer portions, while the rest is moved along to the next zone, of larger holes, which allow the coarser gravel to escape, the small pebbles falling through the next zone, and the larger ones remaining till the last. The different sorts of material are collected in bins, and the washing water, which holds in suspension the fine sand and loam, is allowed to run off into a basin, where it is lightly stirred with paddles agitated by the same power that drives the cylinder. In this basin the fine sand is deposited, but the movement of the water prevents the subsidence of the loamy particles, which escape through an overflow into another basin, and are there allowed to settle quietly. The material shovelled from the bank is thus, by one operation, sorted into large pebbles, small ones, of two or three distinct sizes, gravel, sand, fine sand, and loam. The large pebbles, which are unsuitable for use in making the concrete pipes, are sold for road metal or similar purposes; and the fine, soft deposit of loam in the last basin is disposed of to farmers for manure. The proceeds of the sale of these two products are sufficient to pay the whole expense of handling and treating the earth, leaving the sand and gravel, clean and ready for use in making the concrete pipes, as surplus matter, costing nothing. The ingenious manufacturer has been enabled by this process to reduce the price of his pipes very materially, at the same time that the quality is improved by the thorough washing of the material and separation of the vegetable mould, and it is worth noting that, besides materials for concrete, such a treatment would, in many soils, separate good building sand from alluvial deposits which could not otherwise be used for any building purpose.

THE *Sanitary Engineer* mentions that a company has been formed in Frankfort-on-the-Main which insures against loss or damage from burst or leaky water-pipes or defective fittings. Although it is estimated that damage from these causes occurs about a hundred times as often as injury from fire, the loss is usually not very serious, and the premium rates are low, about nineteen cents, according to the account, being charged for every five hundred dollars insured. We suppose this must be the annual rate. If so, the insurance is incredibly cheap. Few city houses escape for ten years together some damage from water, and, at this rate, supposing the policy on the house to be for five hundred dollars, which would cover any possible damage in an ordinary dwelling, the amount of the premiums paid during that period, including interest, would be little over two dollars. Supposing half the premiums to be absorbed in salaries and expenses, only one dollar would be left at the end of it to pay the plasterer, paper-hanger and fresco-painter for removing the traces of the leak which would by that time have become almost inevitable. If the German Company can make a profit at such prices, it ought to establish representatives here without delay, and we could promise it an enormous business.

ANCIENT AND MODERN LIGHT-HOUSES.[1] — XV.



THE light-houses so far described were built upon solid rocks; the engineers found a stable foundation on which to erect their structures, and if the towers were properly rooted to the rock there would be no fear of their destruction from the undermining or changing of their bases.

But there are many cases where the safety of life and commerce imperatively demands the erection of these guides to mariners on shifting shoals at long distances from shore: then are the difficulties and dangers multiplied many fold, and the skill and ingenuity of the engineer severely taxed. In many localities in this and other countries dangerous outlying shoals are marked by light-ships, but wherever light-houses can replace them, even though a great outlay may be necessary, it is advisable to erect the latter, which need but a few men to attend them, and which make a much more reliable signal, as it is not uncommon for light-ships to be driven from their moorings, thus depriving mariners for a time at least of their friendly light. As examples of how such works have recently been built, I will give a description of the construction of the Rothersand (red sand) light tower in the North Sea, Holland, condensed from a paper read before the Society of Civil Engineers and Architects at Hamburg, the 21st of April, 1886, and also of a similar structure just completed in this country at a shoal called Fourteen Foot Bank, Delaware Bay.

THE ROTHERSAND LIGHT TOWER.

The construction of this tower has a history of many years. The best way to enumerate the many difficulties under which the work was carried on and finally completed is to relate how the project was originated and developed and how at first a failure and later a success was attained.

By an agreement, the bordering states of Prussia, Oldenberg and Bremen bound themselves to mutually regulate the construction and maintenance of the aids to navigation of the Weser, and to meet the necessary expenses by a tax levied upon all the vessels entering the mouth of the river. An inspection tour was to be made annually under Prussia's authority.

In June, 1878, the first inspection drew attention to the imperfect manner in which the entrance to the Weser was lighted, and a light vessel was recommended. But as it was found impossible to moor a vessel securely, it was concluded to attempt the erection of a light tower.

The three above named allies gave Bremen the authority to build it; the matter was referred by the Light-house Establishment of Bremen to its Senate, which detailed Herr Hanks to execute the work.

This gentleman entered into correspondence with the Harkoort Company of Duisburg on the Rhine, in August, 1878, and inquired if this company would undertake the erection of the tower at its own risk, and requested it to submit a proposal.

The tower was to be built on a sandy bottom twenty feet below the surface of the water, was to have a height of ninety-three feet above low water, and to be strong enough to resist heavy seas and floating ice. Herr Hanks suggested a screw pile foundation such as are used in England.

The company expressed its willingness to undertake the work, but proposed a very massive foundation to be sunk by the pneumatic process as preferable to one built of screw piles.

Considerable correspondence ensued and an inspection was made of the site. The latter is thirty-one miles from Bremerhaven, nearly in a straight line to the island of Heligoland, a little nearer the latter, distant from any harbor, and in a locality where winds from the west and northeast get up heavy seas.

[1] Continued from page 74, No. 607.

In addition, it was required that the tower be built close to the fifty-foot channel, which is constantly changing; this precluded the use of any type of foundation except the one proposed by the company, and even this had to be sunk to a considerable depth. Under the circumstances it seemed impossible to erect a working platform, nor would it be prudent to attempt to transport a caisson to the site suspended between two vessels.

Herr Hanks proposed to float the caisson to the locality, to sink it there, and then to fill it with concrete. The company believed this to be a brilliant and practical method, and perfected it by proposing to sink the caisson *on* the sand by filling it with water, and *into* the sand by the pneumatic process, the necessary machinery; namely, boiler, air-pump, air-lock, etc., to be placed within the caisson.

Plans and specifications conforming to the above were submitted on the 7th of February, 1879. The requirements at that time were different from the present tower; it was contemplated to sink it only thirty-eight feet below low water, and to be filled with concrete 13.6 feet above the same level.

While the drawings were being prepared, the Company's engineer who had been engaged on the work unexpectedly resigned. Shortly afterward he and two other engineers formed a company with the intention of competing for the construction of this tower. They were rather premature, however, in their action, as eighteen months elapsed before the fund accumulated from the right dues was large enough to begin the work. On September 15th, 1880, proposals were invited and bidders were furnished with plans and specifications, which, however, were not binding in all their details. The young company mentioned above were very anxious to get the contract, believing that its successful execution would secure them a glorious future.

The Harkoort Company bid 480,500 marks (about $120,125) not including the brush mattresses and rip-rap protection against scour; their competitors bid was 450,000 marks (about $112,500) including the above protection. As after experience showed, this protection cost 110,000 marks, so according to these figures the two estimates differed by 140,500 marks ($35,125.)

The low price at which the contract was taken was the principal cause of its failure. The contractors were compelled to save in the construction of details which should have been executed in the best manner, and were forced to neglect important preparations for which they had neglected to estimate.

The construction of the floating caisson was commenced and completed during the winter of 1880–81. On the morning of May 22, 1881, when there was a dead calm, two tug-boats towed the caisson from the harbor (Kaiser's haven) in Bremerhaven, down the Weser to the site. The caisson was not under good control; rolling heavily, it parted its tow-line in the following night, and went ashore at ebb tide. Next morning at high tide it floated off again, the hawser was refastened, and on the evening of the fourth day from leaving the harbor it had reached the site, and was sunk to the bottom by the rather primitive method of removing a large wooden plug six inches in diameter, located two and one-half feet above the bottom of the caisson. This nearly caused the caisson to upset, but finally at nightfall it reached the bottom.

All this unexpected trouble worried and discouraged the men, who had hardly slept since leaving the harbor — a few of them, under charge of one of the engineers, remained on the caisson; the rest found quarters on the steamer provided for this purpose, and moored at a safe distance from the caisson.

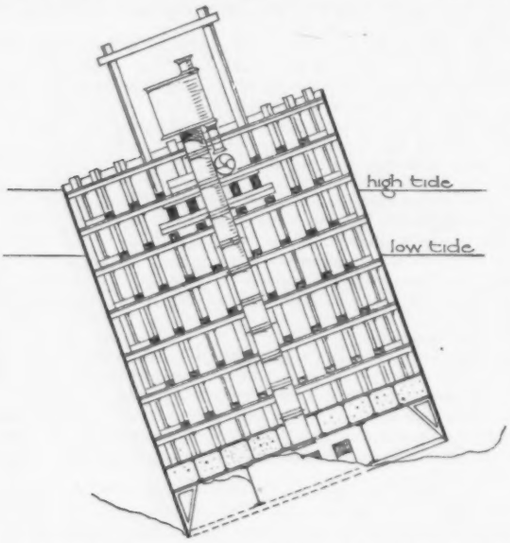
The next morning, when all except the mate of the steamer were sound asleep, he saw through the lifting fog that the caisson was much inclined. It took considerable trouble and time to rouse the tired men and to start the fires under the boilers so as to go to the relief of the excited party on the caisson, who had been awakened at daybreak by being rolled involuntarily from their berths. "That is caused by the ebb current," said the engineer, to encourage his men. "It scours on the south-east side; when the flood sets in and scours the north-west side, everything will be all right." But when the latter came, contrary to his prediction, the caisson inclined still further, until it reached twenty-one degrees from the vertical. The engineer, as well as the men, was greatly relieved when the steamer sent life-boats to take them off; they got on board without loss of time by sliding down a rope. For four days the caisson was left to its fate, and no work could be done on it, as during flood tide the water entered from above (see following cut).

Later, by the counter action of the flood-current, the caisson took a more upright position, about ten degrees from the vertical. Its height was increased six and a half feet before the May storms commenced. When they abated on June 14th, and the working-party returned, they found that the scour caused by the storms had acted favorably; the caisson stood perfectly plumb and had sunk into the sand from seventeen to eighteen feet.

The concrete filling was now commenced and the machinery put in order. A month later the water in the air-shaft and working-chamber was displaced by compressed air, and on August 4th the sinking of the caisson began. During the next two months the weather was fine, and the caisson was sunk nearly twenty-six feet farther into the sand, bringing it seventy feet below low-water mark — a considerably greater depth than the original plan contemplated.

But while this work was going on, the height of the caisson and the amount of concrete filling was but slightly increased, and little was done to protect the caisson from the approaching October

storms. During the May storms, when the upper edge of the caisson was twenty-two and one-half feet above low water, the seas ran so high as to entirely submerge it, yet the iron was carried only twenty-



six feet above low water, and worse than this was the delay in the construction of the brick lining and concrete filling, difficult operations, necessarily consuming much time. In the early part of October the brick lining had not been commenced, the concrete filling was only up to a level with the bottom of the sea, and the brush mattresses and rip-rap were still over thirty feet below low water. In addition, the weak wrought-iron sides were only braced with timbers not strong enough to resist the combined action of the wind and sea.

The contractors were warned of these defects and deficiencies, but did not remedy them, preferring to continue the sinking of the caisson, as, according to agreement, they could draw money by partial payments, the amounts being proportioned to the distance the cutting-edge penetrated the sand.

Of course it was impossible to leave men on this insecure structure, so when bad weather caught them on October 9th, the working-party was compelled to run for a harbor. About three or four miles from the site, and toward the shore, the light-ship "*Brimen*" was moored on the Weser. At noon, on October 13th, 1881, when the lookout accidentally sighted the structure, it seem to him to suddenly disappear. He could not believe his eyes. Grasping his telescope, he scanned the horizon closely, but could find nothing. The tide had risen to a height of sixteen and one-half feet, so that the ironwork projected only a little more than eight feet above the sea. The waves rolled heavily over the structure, breaking or knocking out the iron braces, and the whole work, with the boilers and machinery collapsed. It was reported that the caisson, after penetrating forty feet of sand, had struck a layer of semi-fluid silt, and dropped out of sight. Pictures illustrating this story were printed and circulated.

When fine weather permitted an examination of the site by divers, it was found that the iron mouth of the caisson had been broken off seven feet above the bottom of the sea, and that the boiler and machinery had fallen toward the lee side (south east) of the structure.

The expenditures had been $97,500 to date; of this amount the contractors lost $31,250, their own capital; those who furnished the materials and loaned money lost $46,250, and finally, the Government $20,000, for the total amount ($45,000) of all installments previously paid was only secured by a bond of $25,000.

So ended the first attempt to erect a light-house in the breakers of the "Red Sand" Shoal.

[To be continued.]

Underground Wires.—Mr. W. H. Preece, an English paper says, recently read a paper before the Society of Arts, on "Fifty Years' Progress in Telegraphy." Speaking of underground wires, he says: "In London alone we have 255 miles of pipe, containing 10,212 miles of wire. In fact, all our great trunk lines are out of danger of stoppage from storms. We have 868 miles of open wire included within the metropolitan area, but these are chiefly in the suburbs, and include long, outlying sections, used either for police or fire-brigade wires or for private persons. There are 213 offices in London now served wholly by buried wires." It appears that in 1886 there were in the United Kingdom 26,425 miles of overhead telegraph lines, embracing 150,590 miles of wire, and 677 miles of underground lines, with 19,605 miles of wire. It is estimated that to connect only the more important towns by underground wires, and "uniting those towns by less than half the existing number of overhead wires, would cost something like £2,500,000." Of submarine cable there are now 112,673 nautical miles, which has absorbed a capital of £37,000,000. The larger part of this, or 102,531 miles, is owned by 27 private companies, having from 1 to 53 cables each.

THE ROUND TOWERS OF IRELAND.—I.

Clonmacnoise.

It is not easy to understand, in these days of antiquarian discoveries, when the "hidden things of darkness" are every day being brought to light, that there should be any doubt as to the origin of anything of antiquarian interest, or any difficulty, if doubt exists, in clearing it up. When cities, great in bygone ages, have been completely lost, so utterly ruined and deserted and so absolutely buried by the ever-increasing dust of ages—the very sites of them so entirely obliterated that men begin to speculate as to whether they really ever existed at all, and to tell us that the traditions of our childhood connected with them, and the histories which have been as meat and drink to many a savant for hundreds of years are nothing but absurd fables—when these are being unearthed and such strange discoveries made about them that in a little while we become acquainted with even the manners and customs of the people who lived and thrived in them, is it not a strange thing that there should still be so little known about the origin, use and intention of the Round Towers of Ireland? Theory after theory has been advanced, but not one has taken hold of the majority of antiquarians, or is looked on by those who may be supposed to be interested in the matter as anything more than a theory. Nothing has been satisfactorily proved about their origin, and not much has been *proved* that is of real consequence.

It is said to have been proved without a doubt that they were erected in the course of certain eight centuries, but what a wide margin of speculation this leaves us still. Through what scenes,—peace, war, prosperity, poverty—may not a country pass in the course of eight hundred years. Take old England, for example, in the fifth century and compare it with its appearance in the thirteenth century and what changes do we see? A change from comparative barbarism to civilization, and what greater change could come to a country in a forward direction; but then the period is by no means a limited one. Eight hundred years is not a small portion of a country's history. Let us agree that this was the case, that these towers of Ireland were, as it is said, all erected between the fifth and thirteenth centuries of the Christian era—we shall certainly be on the safe side. We must naturally suppose, then, that there was little or no progress made in Ireland for a whole eight hundred years, that the people went on in the same unchanging round, building in almost the same manner, because the same occasion for the buildings remained, and, therefore, living in the same manner, with no enlargement of ideas, and, therefore, no intercommunication with other lands, no trade nor commerce, which must have brought change, for eight hundred years. It is hardly possible to believe this against the facts of progress that we have of other countries, and, therefore, it must be possible to confine this tower-building fashion to a lesser period, even if it be not possible to settle upon one or two centuries.

The greatest and most convincing evidence that can be produced for the establishment of a theory of progression is undoubtedly the solid witness borne by stones and mortar in which we can trace characteristic details that will leave little room for doubt as to their origin. And here is the great difficulty with regard to this question of Irish round-towers, that between Western Asia and Ireland we can find no towers answering to the description of those we wish, and have reason to expect, to find. Unlike the history of Classic and Gothic architecture, which we are able to trace step by step and mile by mile from Egypt to England, we are here confronted with a break in history as written in the stones of the buildings themselves, we have to come to the end of a string of evidence which has filled us with hope that we might trace, however faint the lines, the existence of some kind of chain of evidence connecting the East with the extreme west of the old world, and search as we will through ancient examples, through Asia Minor and Southern Europe, we cannot discover one tower of the same form.

That there was some early connection between Ireland and the East suggests itself as possible, and it is only after searching high and low that I venture to think I have found some clue. We are so accustomed to trace the well-known forms from land to land, from building to building, and the history of the people among whom we find them is so well known that we hardly stop to investigate the exact circumstances which lead to the reproduction in one country of forms we last saw in another farther east. We know that this and that warlike expedition carried hundreds of men from one place to another, and that in the footprints of armies merchants established their means of traffic and in time of peace these footprints became highroads of commerce. Not only so, but lands yet more distant, and separated by a vast expanse of water, were gradually connected and brought within the reach of trade. Trade bridged these seas, and, whether by land or by sea, customs, fashions, and ideas were disseminated from the older all over the newer countries. Thus far we are able to trace successive steps.

Mr. George Petrie has investigated these towers very carefully, and, in his interesting book on "*The Ecclesiastical Architecture of Ireland*," proves beyond possibility of doubt to himself that they were erected by Christians and for religious purposes. Mr. Fergusson says, and truly, that there is any amount of room for speculation with regard to these towers, not only as to their age, but also as to their use, were it not that Mr. Petrie has already said so definitely that they were for religious purposes. As to their origin, Mr. Fergusson says: "No one supposes that this kind of tower was invented by the rude builders of the early churches, and no theory yet proposed accounts for the perseverance of the Irish in its employment, while the practice of all other nations of Europe was so widely different." Mr. Fergusson, when he writes this, is fully believing in what Mr. Petrie had said, that they were built between the fifth and thirteenth centuries. But I doubt very much if Mr. Petrie meant that the first was built in the fifth and the last in the thirteenth. He takes a long period and says, in effect, somewhere during this eight hundred years these towers were built. Therefore, it does not at all follow that the Irish did so persevere in the practice of round-tower building for so long a period of time, which would, indeed, be contrary to the ways of other nations, not only European, but of all countries in the known world.

Mr. Fergusson goes on to say that they are undoubtedly of Christian origin, as may be gathered from their details, and, describing some of these, he limits the dates of their construction to within two or three hundred years. Here, at least, is something more satisfactory and definite, but this he propounds with doubt. In these towers taken altogether, we may find all kinds of details and all qualities of workmanship, and one is struck by the great difference existing between the characters of towers within a short distance one of another, those apparently of greater age being at greater distances apart, the later ones, as it were, filling up intermediate spaces. From this we may gather that they were originally few and far between, that they were erected just where they were considered necessary, whatever their purpose may have been, and that, as the population increased and new places sprang into existence, so the need, or possibly only the desire, for the towers increased, and others were erected to meet the demand, the details of the later ones differing only slightly from the original ones, and the difference being more in the matter of ornamentation than in construction or general design.

The characteristic of all these towers is the extreme simplicity, and viewed from a short distance, they may all be said to be alike. The principal and most conspicuous difference between them is that of height. The highest is believed to be that at Old Kilcullen, which

St. Bridget's Cathedral and Round Tower, Kildare.

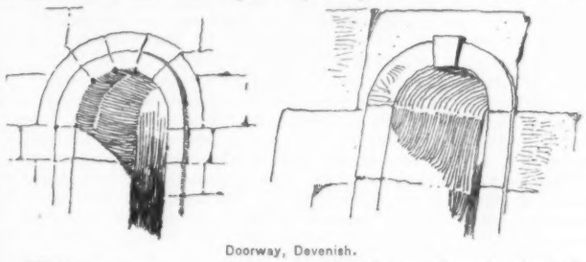
is 130′ high. That at Kildare is 108′ high, 54′ circumference at the top, and this one will serve as an example of the proportions of them all. They vary considerably in height. At Devenish is one only 82′ high, at Kilkenny the tower is 100′ high and 46′ 6″ in circumference at base. To describe the whole, or anything like the whole of over one hundred and twenty of these towers which exist would be a long task and would become uninteresting. Those I have already mentioned and a few others I shall refer to, being sufficient for the purpose.

Kilkenny.

These towers, then, presenting in appearance great hollow pillars, are always circular on plan. They are usually built with rough stones, some very large, others very small, put together in the most haphazard manner just as they come to hand, and with thick joints filled up with cement. As an exception to the rule, the tower at Ardmore is built in regular courses of beautiful ashlarwork, but this tower is an isolated peculiarity, quite different from all the others, and is among the most modern. As a rule, the walls rise without any projecting string or ornament from base to summit, diminishing in diameter as they ascend, and are capped with a conical roof of stone, resting on a slightly projecting cornice. They are hollow from top to bottom, though it is by no means improbable, but rather, highly possible, that they had floors and that these, being of wood, have decayed or been destroyed, and, no doubt, used for firewood. Many of them have been recently fitted up with new floors and ladders for the benefit of the traveller, who seldom fails to put himself to the trouble and exertion of mounting them to see what he can from the top, even if he has no further interest in them, and there is always some one, often the village clerk or sexton, in waiting to benefit also materially from the presence of the stairs and the visitor.

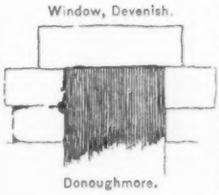
Of external openings there are but few; the door is usually some feet from the ground, and there are no more windows than absolutely necessary for lighting the interior, except in the top story just below the eaves, where there are generally three, four or five windows of equal size and shape, and all at the same level. Windows in the earlier towers are very rudely formed; generally the opening is covered with either a single flat stone or with two stones set on end and meeting so as to form a triangle with the imaginary line drawn across the imposts. Later they were executed with greater care; round heads were attempted, but even these were for a time of the rudest description — two stones placed on the imposts so as to butt together over the centre of the opening, with the under side roughly scooped out so as to form a semi-circle. Door-heads were more often semi-circular than "square" (or flat), but as a rule, the windows are either flat or triangular headed. At Donoghmore, County Meath, is a doorway with an arched head, correctly formed with radiating joints, and this especially deserves notice on account of an attempt at decoration. The imposts are emphasized by the introduction of two rudely-cut heads slightly projecting from the face of the wall. The arch is formed, as I have said, with radiating joints, and the extrados follows the line of the intrados; there is a true keystone of curious form, ornamented with a raised crucifix rudely carved. At Antrim is a doorway the head of which is formed of one large stone lintel, on the top of which lies another large stone, on which is neatly cut a small cross with circle round it. The doorway at Monasterboice is of earlier form, of one stone with the underside hollowed out into the form of a semi-circle, but the joints and architraves are ornamented with a continuous raised but simple "fascia." The sloping jambs of most of the doorways are a feature of interest and worthy of special note, the opening being narrower at the impost than at the sill. Most of the doorways are very simple and have very little ornamentation, but here and there, as if built by a more wealthy community, they are ornamented with mouldings and tracery both on the jambs and soffits of the arches, but all these embellishments are kept *within* the opening, and whenever there is any ornament on the face of the wall, it is executed in very low relief and is of an insignificant character.

Devenish.



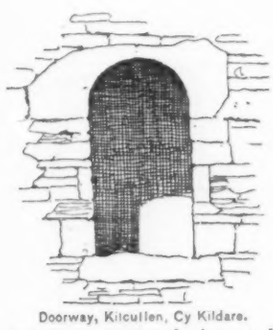
Doorway, Devenish.

Window, Devenish.

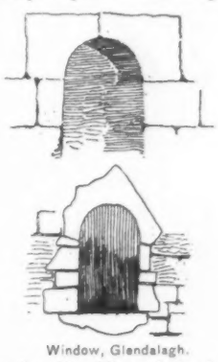


Donoughmore.

Antrim.



Doorway, Kilcullen, Co Kildare.



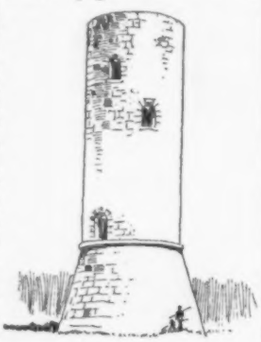
Window, Glendalagh.

As to the windows, these are, as I have said, few and far between in the height of the tower. The majority are flatheaded, and there is no attempt at ornamentation. The conical cap, or roof, sometimes gives place to a battlemented top; when the cap is used, the eaves are made to project considerably beyond the wall. The cone is carried up to its apex in stone to a height averaging ten feet above the eaves. For picturesque effect, the cone is far above the battlements, and there can be little doubt that the latter were an inovation; with the one the tower is complete and looks so, but with the other, the finish is decidedly satisfactory.

Here is an extract from Mr. George Petrie's "*Ecclesiastical Architecture of Ireland*," after which we will leave that country for awhile and take a look round the world and notice other buildings which have, I believe, a decided bearing upon the origin of the round-towers. Mr. Petrie writes with the force of conviction, and puts forth his "Summary of Facts" in a very decided tone. Having described the towers and argued his points, he winds up the matter with the following notes:

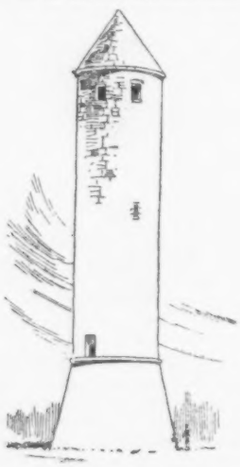
"That not even the shadow of an historical authority has been adduced to show that the Irish were acquainted with the art of constructing an arch, or with the use of lime cement, anterior to the introduction of Christianity into the country, and further, that though we have innumerable remains of buildings of ages antecedent to that period, in no one of them has an arch, or lime cement been found. That in no one building assigned to pagan times, either by historical evidence or popular tradition, has been found either the form or features usual in the round towers, or characteristics that would indicate the possession of sufficient architectural skill in their builders to construct such edifices. That towers are *never* found unconnected with the ancient ecclesiastical foundations. That previous to General Vallancy, a writer remarkable for the daring rashness of his theories, for his looseness in the use of authorities, and for his want of acquaintance with Mediæval antiquities — no writer had ever attributed to the Round Towers any other than Christian, or at least Mediæval origin. That their architectural styles exhibit no features or peculiarities not equally found in the original churches, with which they are locally connected when such remain. That on several of them Christian emblems are observable, and that others display in their details a style of architecture universally acknowledged to belong to Christian times.

"That they possess invariably architectural features not found in any buildings in Ireland ascertained to be of pagan times." After giving a description of some of the towers Mr. Petrie goes on to say, "The preceding description will, I trust, be sufficient to satisfy the reader that the Round Towers were not ill adapted to the double purpose of belfries and castles, for which I have to prove they were chiefly designed, and keeping this double purpose in view, it will, I think, satisfactorily account for these peculiarities in their structure, which would be unnecessary, if they had been constructed for either purpose alone. For example, if they had been erected to serve the purpose of belfries alone, there would be no necessity for making their doorways so small, or placing them at so great a distance from the ground; while on the other hand, if they had been intended solely for ecclesiastical castles, they need not have been of such slender proportions or great altitude.



Brunless.

"It is further certain this use (that of belfry) is assigned to them, by the uniform tradition of the whole people of Ireland, and that they are appointed to this use in many parts of the country even to this day.



Clondalkin.

Roscatberry.

"The most ancient military towers subsequent to Roman times, found in the British Isles, and which are built with stone or lime cement, are invariably of this round and lofty character, having their doorways small and considerably elevated from the ground, and their floors composed of wood.

"As a remarkable instance of the agreement of the British castles with the Irish Round Towers, I annex an outline of the castle of Brunless in its present state. If we restore the outline of this castle to its probable original height, it will be found to be almost identical, in most of its features, with several of our Irish towers, as shown in the annexed outlines of the existing towers of Clondalkin and Roscatberry.

"Abundant evidence exists to prove that the doorways were originally furnished with double doors."

I have given these somewhat lengthy extracts in order that those who have not studied the subject may have some idea of the theories existing about the Round Towers, as well as that they may know the points that are argued, but as we go on with the investigation I think we may see cause to differ.

[To be continued.]

ILLUSTRATIONS

[*Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.*]

VIEW IN JAPAN.

[Gelatine Print, issued only with the Imperial and Gelatine Editions.]

ORANGE CLUB-HOUSE, BRICK CHURCH, N. J. MESSRS. LAMB & RICH, ARCHITECTS, NEW YORK, N. Y.

THIS was the design selected, after competition, for the Orange Club. The building contains an immense two-story hall, ladies' reception-room, library, card-room, café, billiard and pool rooms, two dining-rooms, committee-room, perfectly-appointed toilet-rooms for tennis club, besides about twenty sleeping-rooms, etc.

AN ETCHING BY BRUNET-DEBAINES.

HARFLEUR, once the most thriving seaport of Normandy, has long since given way to Havre, and is now a small town of less than 2,000 inhabitants. The harbor has been filled up by the deposits of the river Lézarde, which here falls into the Seine.

The fine Gothic church of St. Martin, which forms the conspicuous object of the etching, was founded, according to local tradition, by Henry V of England, whose siege of the town is so vividly recorded in Shakespeare. This attribution is, however, probably wrong, as the edifice shows a somewhat later style than that of the period of the besiegement.

Casimir Delavigne said of it:

"*C'est le clocher d' Harfleur, debout pour nous apprendre*
Quel Anglais l'a bâti, mais n'a su le defendre."

which couplet we render (somewhat freely)

"'Tis the steeple of Harfleur, which we apprehend
The English have built, but could not defend."

The church was restored in the sixteenth century. Its interior contains some interesting monuments. A view of the doorway was published in the *American Architect* of September 10, 1887.

The château of Harfleur, a pleasing structure of brick and stone dating from the seventeenth century, was restored by Viollet-le-Duc.

Alfred Brunet-Debaines is a Norman, a native of Havre and a pupil of those distinguished etchers, Gaucherel and Lalanne. He is "*Hors Concours*," having gained two medals at the *Salon*, and one of the most accomplished living masters of the needle, both in original and reproductive etching. Among his original plates are the "Hôtel-Dieu, Paris," "The Château of St. Germain-en-Laye" and "The Interior of the Church of St. Omer, at Pont-Audemer." Besides making various translations of the old masters — notably, Rembrandt's "Mill." M. Brunet-Debaines has etched after Decamps, Daubigny, Corot, Dupré, Français, and other French painters, and executed some important works from English artists, such as Turner's "Burial of Wilkie," Constable's "Valley Farm," David Cox's "Vale of Clwyd," Linnell's "Last Gleam before the Storm," and Millais's "Chill October." One of his finest etchings is the "Church of Santa Maria della Salute, Venice," after the well-known Canaletto in the Louvre, and one of his latest and largest is "Windsor," after Herr Carl Heffner.

The original etching was kindly loaned to us by Messrs. F. Keppel & Co., of New York.

THE "MALTBY" APARTMENT-HOUSE, WASHINGTON, D. C. MR. ROBERT STEAD, ARCHITECT, WASHINGTON, D. C.

THIS building will be erected on New Jersey Avenue, facing the United States Capitol, and will be built of brick laid in red mortar, with Potomac red sandstone trimmings, copper gutters, finals, etc. The owner is Maltby G. Lane of New York.

Design for
Club House - Brick Church, N. J.
Lamb and Rich Architects
Grand Hall - Entrance

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A. Brunet-Debaines. 95

The Malta Apartment House.

Robert Stead, Architect, Washington, D.C.

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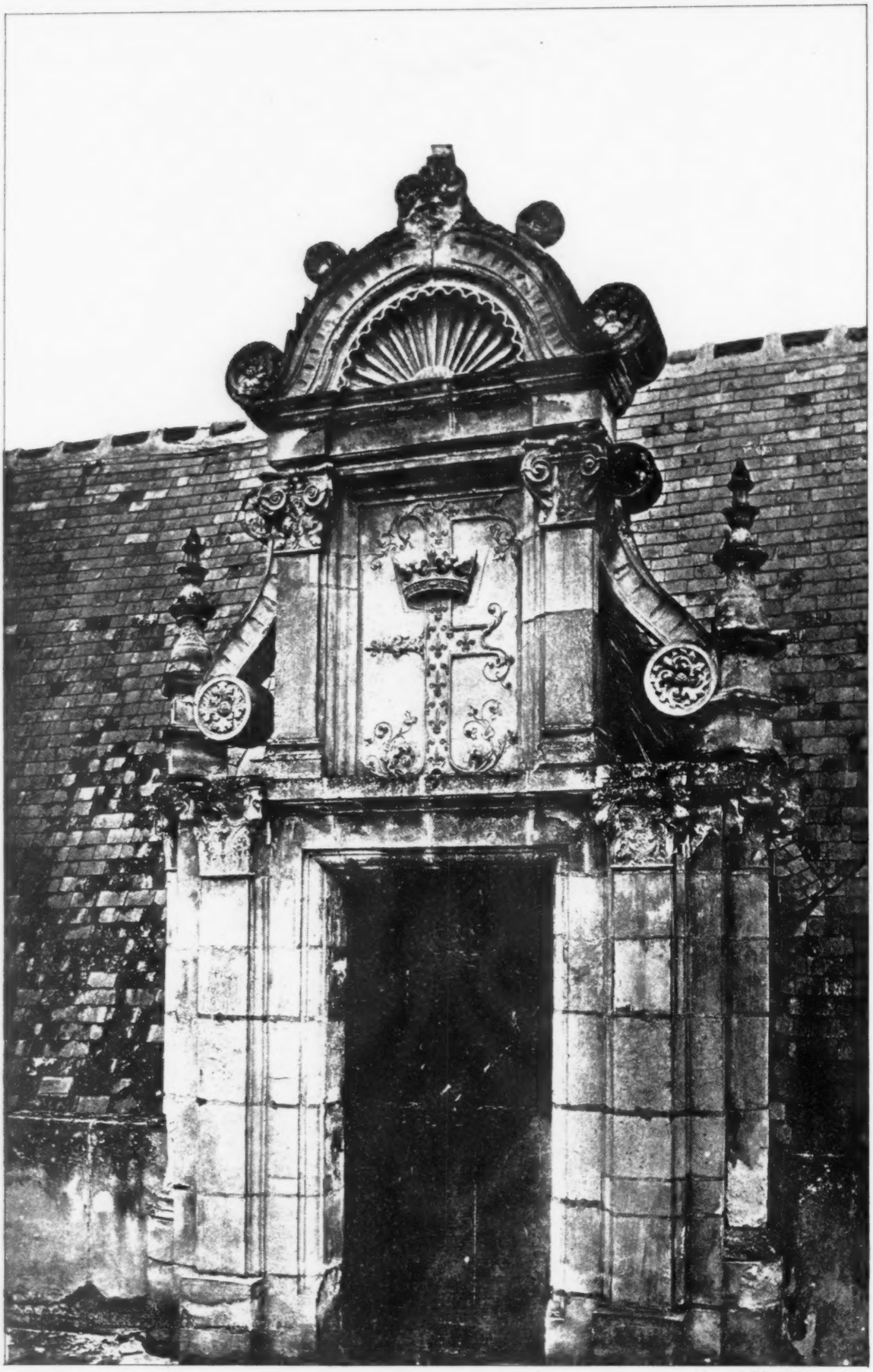

Heliotype Printing Co. Boston.

Dormer, Chateau de Blois

American Architect and Building News, Sept. 24 1887. No. 613

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House for Mrs C.T. Sisson. Hyde Park. Ill.

J.H.E. Iliot. Architect. Chicago.

Heliotype Printing Co. Boston

HOUSE FOR MRS. C. T. SISSON, HYDE PARK, ILL. MR. J. H. ELLIOT, ARCHITECT, CHICAGO, ILL.

THIS house, now building, will cost about $5,000.

A DORMER. CHATEAU DE BLOIS, FRANCE.

BUILDING MATERIALS.[1]—V.

OF all natural productions, there is not one that is of greater importance to the builder, or that is applicable to so many manufacturing purposes, as limestone, this being the general term by which all rocks may be designated which have carbonate of lime for their basis. These calcareous deposits belong to several geological formations, and differ materially from each other both as regards their chemical composition and their physical character, being sometimes in the form of a dense hard rock, as is the case in what is known as carboniferous or mountain limestone, many of the beds of which are of great thickness, consisting of nearly pure carbonate of lime. In the limestones of the Lias, on the contrary, the carbonate of lime is associated with silica and alumina in proportions varying from ten to twenty per cent, of which we have examples in the limestone of Aberthaw, in Glamorganshire, the Barrow limestone in Leicestershire, and the limestone of Warwickshire. These Lias deposits consist of comparatively thin layers of hard limestone separated by others of a more argillaceous character, or shales, containing various proportions of carbonate of lime. The Lias district extends from Lyme Regis, in Dorsetshire, to the northeast of Yorkshire, the limestone being worked chiefly in the counties of Dorset, Warwick and Leicester, yielding, when calcined, the best description of hydraulic lime. In the chalk districts of Kent and Surry, we have in the upper white chalk a soft description of comparatively pure carbonate of lime, and in the gray chalk which lies immediately below it we have a carbonate of lime of a somewhat harder description, associated with a small proportion of argillaceous matter.

One of the most wonderful and curious formations of limestone is that which results from the agency of the coral polype, which possesses a power of abstracting carbonate of lime from the water of the ocean, and is thus enabled in warm climates to construct those enormous reefs which, in some cases, extend for hundred of miles in the Pacific and Indian seas. The coral, as produced, is carbonate of lime, soft and porous at first, but it gradually becomes hard and compact, so much so that it is capable of being used as a building stone, as is the case in some of the South Sea Islands. In the course of its formation, all kinds of marine *débris* get mingled with it, which, when cemented together, produces a rock that bears a resemblance to some descriptions of the older limestones. The sediment resulting from the trituration of the coral when deposited in sheltered water channels, produces a material similar in appearance to chalk, whilst the coral from reefs that have been upheaved by volcanic agency, is found to be of a sparry or crystalline character. These coral reefs occur in every stage of development, from the coral that is daily growing to that of a compact solid mass resembling some of the softer marbles, and thus, owing to the changes that take place from the action of the waves, and to the elevation or depression of the ocean bed, a coral reef eventually becomes a more or less compact limestone, so that as the result of the labors of the coral polype, we have deposits which represent several varieties of limestone.

Carbonate of lime is found in a state of chemical purity in rhombohedral crystals, as Iceland spar, which (as is well known) possesses the property of refracting light in a peculiar and remarkable manner, and has hence received the name of double refracting spar. Carbonate of lime is also found in six-sided prisms, known to mineralogists as aragonite, so called from Aragon, where it occurs in large macled crystals, in the gypsum deposits in that part of Spain. The form of crystal assumed by carbonate of lime depends upon the circumstances under which the crystalization takes place, such as temperature (the tendency to the formation of aragonite being greatest when it crystalizes from warm solutions), the degree of concentration of the solution, and the presence of foreign substances. Its purest form as a rock is that of white marble, the colored marbles containing iron, manganese, and carbonaceous matter. The proportion which the carbonic acid bears to the lime is as twenty-two to twenty-eight, lime itself being an oxide of calcium. Calcium is a light malleable metal, somewhat harder than lead, tarnishing rapidly on exposure to the air by the absorption of oxygen; when heated to redness it burns with a brilliant, scintillating white light. It has not received any practical application in the arts, and is only capable of being produced in very small quantities for experimental purposes.

By exposure to a red heat, under ordinary circumstances, carbonate of lime is decomposed, the carbonic acid is driven off, and the lime remains in an uncombined or caustic state. The time required for completing this decomposition depends upon the character of the limestone, and the circumstances under which the "burning" (as it is termed) of the limestone is conducted.

If carbonate of lime be heated in a confined space, such as a close retort, where there is no possibility of the escape of carbonic acid, complete decomposition cannot take place, however high the temperature may be raised; the limestone becomes surrounded with an atmosphere of carbonic acid, and until this is removed its further decomposition is arrested. Chalk under such circumstances may assume a highly crystalline condition, and thus in nature we find dull granular limestones that have been altered in their character by the intrusion of an igneous rock; we have an example of such conversion in Rathlin Island, off the north coast of Ireland, where two basalt dykes ascend through the chalk, converting the latter into a fine granular marble. Experiments were made many years ago which proved that when the carbonic acid liberated was rapidly carried off by a current of steam or air, the rapidity with which the limestone was decomposed was increased, a fact which it may be well to remember in discussing the merits of different modes of calcining. The process of "lime burning" is carried out in several different ways, in comparing the advantages of which it is necessary that the various circumstances that bear upon the question, such as the character of the stone and the amount of lime that can be disposed of in a given time should be considered.

Whether the operation be carried out in the simplest manner, or in the kilns constructed on the most scientific principles, much will still depend (both as regards the quality and quantity of the lime produced) upon the kilnsman, for it is only by constant observation from day to day that the eye becomes capable of judging whether the proper temperature has been reached, or that a correct opinion can be formed as to the effects produced by the various disturbing causes which exert an important influence upon the working of a kiln, such as its size, shape, the character of the limestone, the quality of the fuel, and the state of the atmosphere.

The kilns usually employed vary as regards size and shape in different districts, consisting generally of inverted cones or ellipsoids, into which layers of limestone and fuel are alternately thrown. When worked continuously as running kilns, the lime is periodically withdrawn from below, fresh quantities of stone and fuel being filled in at the top. It is obvious that the consumption of fuel must be much less when worked continuously than is the case when, after every charge, the kiln is allowed to cool down before the lime is removed. It is very difficult (even when every care is taken) to obtain from ordinary kilns, when worked continuously, a uniformly satisfactory product; the temperature is not sufficiently under control, and sometimes increases more rapidly in one part of the kiln than it does in another; or not unfrequently a block occurs, and a mass of stone and fuel remains immovable for a considerable time, and when this stoppage is overcome the mass gives way, and a quantity of lime and half-calcined limestone comes down together. Owing to these uncertainties, which no precautions can entirely guard against, when it is essential that the limestone should be equally and thoroughly calcined, the kilns are worked on the intermittent system, the charge being put in at once, and the kiln allowed to cool down before the lime is removed, the extra cost of fuel being more than compensated for by the superior quality of the lime obtained.

In the chalk districts, in which what is termed "flare lime" is produced, to distinguish it from the lime as obtained from the kilns to which I have referred, the process is carried out in a somewhat different manner. Only a small quantity of fuel is mixed with the chalk, its calcination being chiefly effected by the flames of the burning coal placed below. A fire-place is constructed in the outer wall of the kiln of brick arches, these arches being continued within the kiln by piling up large blocks of chalk, over which the remainder of the chalk is filled in; the fire below the arches is lighted, and when the whole mass has attained the requisite temperature (which is determined by the experienced eye of the kilnsman), the fire is allowed to burn out, and the lime, when cold, is withdrawn. These kilns will turn out about thirty tons of lime with a consumption of about nine tons of coal. A variety of kilns have from time to time been proposed with the view of diminishing the consumption of coal, few of which have been constructed on sounder principles, or have been more successful in attaining the desired object, than those of Hoff mann, which are frequently alluded to under the name of circular or ring kilns.

The great economy as regards fuel, effected by the use of kilns of this description, is obtained by causing all the air entering the kiln to pass over the lime that has already been calcined before it reaches the burning fuel, and the products of combustion, together with the

[1] A lecture by W. Y. Dent, F.C.S., F.I.C., read before the Society of Arts, and published in the *Journal* of the Society. Continued from page 135, No. 612.

carbonic acid and vapor of water from the limestone, to pass over the fresh limestone before reaching the chimney. By the arrangement adopted, the air is raised to a high temperature before it reaches the fuel by taking up the waste heat from the hot lime, which in ordinary kilns is entirely lost. Combustion takes place under the most favorable conditions, the fuel being consumed in the most perfect manner, with scarcely any escape of smoke. The heat recovered from the gases evolved is sufficient to raise a portion of the limestone almost to dull redness before it meets with the burning fuel, and the amount of heat that escapes is little more than what is required to create a sufficient draught in the chimney.

The kiln consists of a flat-roofed circular or elliptical tunnel, divided into twelve or more chambers, placed round a central chimney-shaft; the flues which connect each chamber with the central chimney are so arranged as to be capable of being closed at pleasure. Two adjoining chambers of this series are opened (generally every day), in one of which the operation of charging with fresh limestone is going on, whilst the lime is being taken from the other. The air entering at these open chambers passes through four chambers filled with hot lime, which it cools down, becoming more and more heated before it reaches the two or three chambers in which the fuel is being consumed, and afterwards passes through the remaining chambers of the series filled with fresh limestone, finally reaching the chimney through the flue of the last chamber that had been filled on the previous day.

The fuel used is small coal, which is thrown in at the top of the flat roof of the kiln in very small quantities at a time through openings communicating with shafts that are left to receive it when stacking the limestone. These openings are closed by loose covers that are only lifted at the moment when the coal is put in, or for the purpose of observing how the kiln is working.

The kilns are constructed on a very large scale, each of the chambers in a kiln which has now been worked for twenty years in North Wales being capable of turning out twenty tons of lime. The building of such kilns involves a large outlay of capital, and it is necessary that they should be kept going constantly and regularly, as the kiln after having been once lighted is never allowed to go out, every chamber taking its turn for the operations of filling, firing and discharging. It is evident under these circumstances that kilns of this description are most suitable for large works and where there is a constant demand for the lime produced.

Another description of kiln has recently been brought out for burning lime and cement, known as the Dietzsch kiln, which is still more economical as regards the consumption of fuel than Hoffmann's, inasmuch as there is less waste of heat, owing to the portion of the kiln in which calcination takes place never being allowed to cool except for repairs. This kiln consists of a vertical shaft, divided horizontally into two parts, which are connected together by a short horizontal chamber. The upper part of the shaft is kept charged with the raw material, which gradually falls by its own weight into the horizontal chamber, from which it is passed on as required, by means of shovels, to that part of the lower portion of the shaft in which its calcination is completed, and which is maintained at a high temperature by the continual addition of fuel (in small quantities at a time), through apertures made for this purpose and for stoking. The calcined material is allowed to fall into a cooling chamber, through which air is supplied to the kiln. By this arrangement the cement or lime does not remain in contact with the fuel for a longer time than is necessary for its calcination, and no heat it wasted in having to warm up the walls of the kiln after every discharge. The air supplied to the kiln is warmed by passing over the calcined mass, which it cools, whilst the gases produced by the combustion of the fuel give up the greater portion of their heat to the freshly-charged material before escaping from the top of the shaft. It is stated that in a kiln of this description a ton of cement does not require more than from two to three hundredweight of small coal for its calcination. The Dietzsch kiln has only quite recently been introduced into this country. Its construction is simple, but it requires more constant attention than ordinary kilns.

It has been proposed to use gas as the fuel for lime-burning, a plan which has the advantage of not bringing the lime into contact with coal or coke, and consequently produces a lime of better color. Although attempts have been made to adopt this process on a considerable scale, I am not aware of their having been brought to a successful issue in this country, owing to the difficulty that has been experienced in so regulating the supply of gas and air as to insure the ignition of the mixed gases taking place in such a manner as to produce a uniform temperature throughout the mass of limestone, and in making the kiln gas-tight. It may be anticipated that, with more experience, these difficulties will disappear, but at present the Hoffmann kiln for lime-burning is entitled, by long experience of its merits, to be considered as one of the best, both as regards efficiency and economy.

When lime has not been properly calcined and will not slake with water, it is termed "dead burnt," which may arise from two causes: from insufficient burning, when the limestone, instead of being entirely caustified, has only been changed into a basic carbonate consisting of two equivalents of lime and one of carbonic acid, one-half only of its carbonic acid having been expelled; this basic carbonate, on the addition of water, instead of forming a hydrate of lime and being converted into a fine impalpable powder, attended with the production of a large amount of heat, is changed with but comparatively little elevation of temperature into a mixture of hydrate and carbonate.

In the case of hydraulic limes which contain a considerable amount of silica, this "dead burning" may arise from the limestone having been subjected to too high a temperature, whereby a partial fusion of the silicate of lime formed has been produced, giving an impervious coating to the inner portions of the stone, which retards the further evolution of carbonic acid. On this account the eminently hydraulic limes require to be carefully calcined at as low a temperature as practicable, and hence, we not unfrequently find that lias lime has been imperfectly calcined. Pure limes, if subjected to too high a temperature, exhibit somewhat less tendency to combine with water than is the case with lime that has been properly calcined.

Caustic lime unites with water with great energy, so much so as to evolve a very considerable amount of heat. When water is poured upon a piece of well-burnt pure lime, heat is rapidly generated, and the lime breaks up with a hissing, crackling noise, the whole mass being converted in a short time into a soft, impalpable powder known as "slaked lime;" chemically speaking, it is a hydrate of lime, that is, lime chemically combined with a definite amount of water. In the process that is termed slaking, one equivalent or combining proportion of lime unites with one equivalent of water, or in actual weight, twenty-eight pounds of lime combine with nine pounds of water (being nearly in the proportion of three to one) to form thirty-seven pounds of solid hydrate of lime; the water loses its liquid condition, and it is to this solidification of water that the heat developed during the process of slaking is partly due. In the conversion of a solid body into a liquid, as is the case in melting ice, a certain amount of sensible heat is rendered latent, and in reassuming the solid condition this amount of heat is again rendered sensible. In slaking lime, however, a much larger amount of heat is developed than is derived from the solidification of water, which further development of heat is to be ascribed to the chemical action which takes place between the water and the lime, for chemical combination, in by far the greater number of cases, is attended with evolution of heat. The heat thus generated may be perceptible to the senses or not, according to the circumstances — thus, for instance, when carbonate of lime is decomposed by the addition of an acid, the heat developed may not be observed, because a large proportion is absorbed in the conversion of the carbonic acid from the solid form in which it existed as carbonate of lime into a gaseous state.

The heat generated by slaking lime has been made use of as a perfectly safe means of obtaining coal in fiery mines without the necessity for using gunpowder or any other explosive. A hole is bored in the seam of coal about three feet in length, and two and a half inches in diameter, into which is inserted a perforated iron tube of about half an inch in diameter, covered with a strip of canvas in order to prevent the perforations being closed by particles of lime. The hole is then nearly filled by putting in a number of short cylinders of highly-compressed lime, in which a groove is left to receive the iron tube, the charge being completed by six inches of well-rammed clay tamping; water is now forced down the iron tube, and in a few seconds the lime begins to swell, producing a quantity of steam under considerable pressure, which tends to crack the surrounding mass of coal. The temperature never exceeds 800° Fahr., so that in the most fiery mines there is never sufficient heat generated to give rise to an explosion.

The manner in which the process of slaking lime is conducted is a matter of considerable importance, because if this operation is imperfectly carried out, the plaster made from such lime will be liable to blister, owing to the subsequent slaking of small particles of lime still remaining in a caustic state, and these blisters will not unfrequently make their appearance after the lapse of a considerable time. All "rich" or "fat" limes (as those limes are termed which are obtained from pure limestones) may be slaked by mixing with a sufficient quantity of water to reduce the whole to a thick pulp, and are not in any way injured by remaining in this condition for a considerable period. In the preparation of plaster for fresco-painting, it is customary to employ lime that has been kept for a long time in the state of thick paste, so as to secure the hydration of every particle, for it is well known that the smallest portion of unslaked lime would be fatal to the plaster as a suitable material for the ground of any decorative work of art.

With the eminently hydraulic limes, on the contrary, it is necessary to adopt a different mode of proceeding, inasmuch as it is requisite that care should be taken in slaking limes of this description that too large a quantity of water should not be employed.

The energy with which hydraulic limes combine with water is not nearly so great as is the case with pure limes, and if too much water be added, and the lime is flooded, the slight amount of heat generated is absorbed. If limes of this description be allowed to remain for any length of time in a pasty condition, hydrated silicates of lime and alumina begin to be formed, and if these silicates be disturbed and broken up, the power of the lime to set subsequently is diminished. In slaking hydraulic limes, no more water should be used than is necessary to secure hydration. The slaking of such lime is carried out in practice by sprinkling water over a heap of lime, and covering it over with the sand that is intended to be mixed with it when converting it into mortar, the covering of sand serving to retain the heat that is developed, so as to enable the process of slaking to be carried out slowly throughout the mass.

By exposure to air caustic lime is slowly converted, without much

elevation of temperature, into a coarse powder, consisting of a hydrate and carbonate of lime.

Mortar consists of a mixture of slaked lime and sand, in the condition of a thick paste, which is spread in thin layers between bricks or stone for the purpose of cementing them together; the effect of the sand is to increase the points of attachment, and to render the mortar open in its texture, hence it is that the more irregular and angular are the particles of sand the better is it adapted for the purposes of mortar-making. In mortar required for plastering it is necessary that the sand used should be free from salt, and that no brackish water should be employed, on account of its containing deliquescent salts, which have a great tendency to absorb moisture, and consequently to render the plaster always liable to become damp.

The hardening of mortar is due to several causes which act collectively. In mortar made from pure or rich limes the first setting is due simply to the evaporation of the water, and to the production of minute crystals of hydrate of lime; this hydrate then slowly absorbs carbonic acid from the air, the rapidity of this absorption necessarily decreasing in proportion to the difficulties presented to the free access of air. This being the case, it is manifest that pure limes are not suitable for mortar to be used for thick massive walls, or in places where it is likely to be exposed to the action of water. It is a well-established fact that, in very heavy masonry, mortar made from pure lime may remain for an almost indefinite period in its original soft condition. In the case of mortar made from hydraulic limes, it is necessary that the mixing of the mortar should be completed as rapidly as is compatible with the thorough incorporation of the materials, and that it should be used as soon as practicable after having been mixed, for if mortar of this description be put aside for any length of time, its setting properties are deteriorated.

The pure limes are undoubtedly the most effective when lime is required for disinfecting or sanitary purposes, as, weight for weight, they contain more lime than the hydraulic limes, but for the use of the builder there can be no question but that those which partake more or less of the character of hydraulic lime are most suitable; the mortar of such lime sets quicker and much harder than is the case with mortar made from the purer descriptions of lime. It is on this account that the gray Dorking lime made from the lower chalk is preferred for building purposes to that made from the upper chalk. Mortar for hydraulic purposes may also be made by mixing with the pure limes calcareous clays or shales, which have been so altered by the agency of heat that the silica they contain has to some extent assumed the condition of soluble silica. The mortar which was held in such high estimation by the Romans consisted of lime mixed with puzzuolana, so named from a small town at the foot of Mount Vesuvius, in the neighborhood of which it was first obtained. It is also found in other localities which have been subjected to volcanic eruptions. This puzzuolana is an altered felspathic tufa, the silica of which has been so changed in its character as to be in a more or less soluble condition.

Trass is a material similar in its character to puzzuolana, obtained from the pits of extinct volcanoes in the valleys of the Rhine, between Mayence and Cologne, as well as in various parts of Holland. It is held in high reputation by Dutch engineers, the name trass being derived from a Dutch word signifying a binding or adhesive substance.

There is a great want of uniformity in the chemical composition of these volcanic products, which necessarily give rise to uncertainty in the composition and character of the supplies obtained, and their use is now to a great extent superseded by the substitution of hydraulic lime or cement.

HYDRAULIC CEMENTS.

The first hydraulic cements made in this country were obtained by burning natural cement stones, a patent having been taken out in 1796 for the preparation of what was improperly termed "Roman" cement from the calcareous clay nodules known by the name of septaria, which are obtained in considerable quantities on the Kentish and Essex coasts, the chief supplies being procured from Isle of Sheppey and the neighborhood of Harwich, were they are dredged up from the sea at low water. The composition of these nodules varies considerably, but they may be regarded generally as consisting of from about fifty to sixty-five per cent of carbonate of lime associated with argillaceous matter containing oxide of iron.

The Mulgrave cement made at Whitby from stone found on the east coast of Yorkshire, the Medina cement from the Isle of Wight, as well as various quick-setting cements made in different parts of the country, may be regarded as more or less partaking of the same character as the so-called Roman cement. The operation of burning these natural cement stones is a very simple one, but requires care and experience, the object sought to be attained being to drive off the carbonic acid from the carbonate of lime, and to cause the silica of the argillaceous portion of the stones to enter into combination with the lime, forming silicates that are capable of being readily attacked by hydrochloric acid. To effect this a very high temperature is not necessary, and should indeed be avoided, for many of these natural stones, if exposed to the same temperature as that which is employed in the manufacture of Portland cement, would undergo partial vitrification, and would no longer, when mixed with water, possess the setting properties of cement. The stone is burnt in a kiln worked on the intermittent system, and afterwards ground to powder, the quality of the cement depending upon a proper selection of the stone and the care taken in firing. The trade in Roman cement was at one time of so much importance that the question was raised whether foreign vessels should be allowed to dredge for the stone off the English coasts; but partly owing to increased supplies of material from which cement answering all the purposes of the original Roman can be prepared, but chiefly to its having been superseded by Portland cement for all purposes where strength and durability are required, the Roman cement manufacture has ceased to possess any especial interest. The cement known as Portland, which was so named from a fancied resemblance of blocks of this material to Portland stone, far exceeds in importance every other description of cement, both as regards the extent of the manufacture and the purposes to which it is applied. A patent was taken out for the manufacture of this material, in the year 1824, by Mr. Joseph Aspdin, a Yorkshire bricklayer, who states in his specification that he mixes powdered limestone and argillaceous earth in a fine state of division with water, then evaporates the water, and calcines the mass in a furnace until the carbonic acid is entirely expelled, and this is essentially a description of what is done at the present time. This was not the first attempt at the artificial preparation of hydraulic cement, inasmuch as so far back as 1810, a patent was granted to Edgar Dobbs, for burning a mixture of lime, clay, or any earthy material, for the manufacture of cement, and in 1818 another patent was taken out by Maurice St. Leger, for the use of a mixture of chalk or lime with clay or any substance consisting of silica and alumina; this mixture was to be made into a paste with water, dried and burnt in a kiln. For some time prior to Aspdin taking out his patent, the well-known French Engineer, M. Vicat, had been engaged in carrying out a series of experiments on the subject of hydraulic limes and cements, and an investigation of the subject was also undertaken by General Sir Chas. Pasley in 1826, at Chatham, who, in the course of his experiments, was the first to make use of the Medway blue clay, which has since been the principal source of the supplies of silica and alumina required for the manufacture of Portland cement in the chalk districts. It is a curious fact that in the early attempts to prepare Portland cement from artificial mixtures of clay and chalk, great care was taken to avoid too high a temperature in the kiln, and the light-colored underburnt pieces (such as are now returned back to the kiln to be more thoroughly calcined) were regarded as yielding the best cement. The first to establish works on the Thames for the manufacture of Portland cement was Mr. Frost, who, about the same time that General Pasley commenced his experiments, erected kilns at Swanscombe, which were subsequently transferred to Messrs. White Bros., who have since that time continued the manufacture. Some time afterwards a son of Mr. Aspdin established works in the same neighborhood at Northfleet, a place that is now almost entirely devoted to the cement trade.

For some considerable time the quantity produced was very small, whilst the quality produced was variable, and could not be depended upon, and so little was the new cement appreciated, that in 1833, whilst Roman cement was selling at 1*s* 6*d* per bushel, only 1*s* could be obtained for Portland. The trade has now become an important branch of national industry, every year new works are commenced, or old ones enlarged and supplied with new and improved machinery for saving labor, the demand for the article keeping pace with the increased supply. English makers are now so closely pressed, both as regards quality and price, by their German competitors, that it is only by exercising the greatest economy, and the production of the best quality, that they can hope to succeed in maintaining their position. The valuable qualities of this cement were early appreciated by the French engineers, and a large quantity of English-made cement was employed in the construction of the French docks and harbors.

The greater portion of the cement made in this country is manufactured at the numerous works situated on the Thames and the Medway, the materials from which it is prepared being simply chalk and clay. The upper chalk, or that in which flints most abound, is that which is employed on the Thames, the gray chalk which lies immediately below it being also used on the Medway.

The clay used for mixing with the chalk is obtained by dredging at low water on the banks of the Medway. Care must be taken in obtaining it that it is free from sand, and that it contains no fibrous vegetable matter; in the condition in which it reaches the work it contains about forty per cent of water. There is nothing very peculiar in the composition of this particular clay that should render its use essential for the manufacture of good Portland cement, the gault clay, as well as other descriptions of clay, being applicable for this purpose; any unctuous clay in which the proportion of alumina is considerable, that is free from sand and other impurities, and is capable of being reduced to a fine state of division, can be used for the manufacture of Portland cement. The clay and chalk in the proportion of three parts of the upper chalk or four parts of the gray chalk to one part of clay are thrown together, with a quantity of water, into a wash mill, which consists of a large circular trough (varying somewhat as regards character and size, but being generally about eighteen feet in diameter) in which the mixture is ground by means of a revolving beam to which heavy bars of iron are attached, to the condition of a fine semi-fluid mud, or "slurry" as it is termed. The slurry is then pumped up to be further ground, either between rollers or by horizontal stones, and passed thence to the drying floors.

Until within the last few years a very much larger quantity of

water was put into the wash-mill than is now generally the case, the slurry being pumped up into reservoirs or "backs" (as they are termed), where it remains until the mixture of clay and chalk, held in suspension by the water, had deposited, when the supernatant water was drawn off, and the slurry, as soon as it had attained sufficient consistency, had to be wheeled away in barrows to the drying stoves. This system necessarily involves a great deal of manual labor, besides a considerable loss of time, several weeks being required to allow the particles of clay and chalk to subside; this method was, moreover, not conducive to the uniformity of the mixture, owing to the tendency of the heavier particles to deposit before those which are lighter. It is now the custom in most works to put only just enough water into the wash-mill to make the slurry of a sufficiently-liquid consistency to allow of its being removed by pumps. The drying of the slurry, instead of being conducted as formerly in special ovens heated by coke, is now carried out in chambers erected on a level with the top of the kiln, these chambers being heated by the waste gases from the kiln, as they pass on to the chimney. The kilns in which the cement is burnt are closed at the top, the products of combustion being carried through the chambers containing the slurry, so that, as soon as the turning of a batch of cement in the kiln has been completed, a further quantity of slurry is sufficiently dried for another charge, and as this is already on a level with the top of the kiln, the operation of filling the kiln is facilitated.

The kilns ordinarily employed for burning cement are somewhat similar in their construction to those used in burning lime, and are generally worked on the intermittent system, the difficulty experienced in working ordinary kilns continuously being quite as great in the case of cement as it is in burning lime. The Hoffmann kiln, which is largely used in Germany for cement, has not been adopted to any extent by English manufacturers; this may, perhaps, be partly accounted for by the fact that, in the chalk districts, the dry slurry is always, to some extent, in the condition of dry powder, whereas the materials for German cements are generally mixed dry, and moistened with water, and then made up into bricks before firing.

The object to be attained in burning cement is not merely to drive off the carbonic acid from the chalk, and to effect the transformation of the silica of the clay from an insoluble into a soluble condition, but also to bring about those combinations of silica, alumina and lime, which require a very high temperature for their production, giving rise to a hard, almost semi-vitrified clinker. So far from being injured by being exposed to a very high temperature (as is the case with natural cement stones), Portland cement cannot be manufactured of full strength without being subjected to such a temperature, although it must not be so great as to produce actual fusion, for under such circumstances the material would be useless for cement. The conversion of the silica of the clay into a soluble condition will be found to have taken place in the half-burnt, yellowish pieces of cement that are returned to the kiln to be reheated, in which even some of the chalk is not calcined. The difference between a lightly-burnt cement and a well-burnt clinker would appear to be due to the action of alumina, and the part it plays in the formation of double silicates of alumina and lime, and aluminates of lime. It was shown by M. Frémy, many years ago, that aluminates of lime obtained by subjecting mixtures of pure alumina and lime (consisting of one equivalent of alumina with one, two or three equivalents of lime), to a very high temperature produce, when mixed with water, hydrated aluminates of lime, which not only possess the property of hardening under water, but are capable of binding together very large quantities of sand into a mass possessing the hardness of stone. In the Lias districts in Warwickshire the limestone (which is of a harder description than chalk), and the shales which take the place of mud, are passed through toothed rollers and ground to a fine powder by horizontal stones. The powder is mixed in a pugmill, with as much water as is necessary to form a soft paste of sufficient plasticity to be capable of being separated into pieces about the size of bricks which, when dried, are ready for the kiln.

When drawn from the kiln, the calcined cement is crushed between rollers and ground to a fine powder by horizontal stones of the same description as those used in flour mills. Since it is necessary in order to obtain the strong cements now demanded, that the mixture of chalk and clay should be heated to such an extent as to bring it into the condition of a hard clinker, the question of its being sufficiently ground has become one of great importance, on account of the difficulty experienced in reducing such a hard material to a very fine state of division. Unless the cement be ground fine its binding properties cannot be developed, and the quantity of sand it will bear mixing with is diminished. The coarse particles of cement which will not pass through a fifty-mesh sieve are totally inert as a binding material; they will not even adhere together, although they may be converted, by simply grinding to powder, into an excellent cement. There can be no doubt but that the finer a cement is ground, the better it is; it would, however, be manifestly impracticable to reduce a hard, well-burned clinker to an impalpable powder; the fineness must be limited by the cost of grinding. A few years ago a cement was thought to be sufficiently ground if eighty per cent would pass through a fifty-mesh sieve; now, however, it is required that ninety per cent should pass a seventy-six mesh sieve, or 5,800 meshes to the square inch.

When ground, the cement is conveyed to a store (the results of several day's grinding being mixed together so as to insure, as far as possible, uniformity throughout the bulk), where it should remain for three weeks or a month before being issued. However well made a cement may be, yet if it be mixed with water too soon after grinding, heat is generated, and it is liable to swell and crack; hence the necessity of making up small blocks, and observing whether any rise of temperature takes place on the addition of water, and whether, subsequently, any cracks make their appearance. Cement, to set properly, requires an ample supply of water, and will sometimes, if applied to a very dry wall, not adhere to it properly from deficiency of water. It would appear that the benefit derived from immersion in water continues for a considerable period, judging from an experiment made with two briquettes of the same cement, one of which was kept three years in air, and the other in water. The one which had been kept in water gave the highest breaking strain, had a more crystalline fracture, and contained more water in chemical combination than the briquette that had been kept in air for the same period.

[To be continued.]

BOOKS AND PAPERS.

ANTOINE JEAN GROS[1] is an instance of a child born with a passionate love of painting. At eight years of age he covered his school-books with sketches, and at fourteen he entered the atelier of Louis David. His father being a miniature painter of some talent and a friend of Madame Lebrun, the child passed his days in the atmosphere of art. But the father was a prudent man, and, having known something of the difficulties of an artist's life, he was determined that his son should not enter upon it without having proved his vocation beyond any doubt. Accordingly, he took the boy to an exhibition of pictures and told him to chose his master from the works on view. Without any hesitation the child chose the "Andromaque," by David, and this early admiration for his master remained with him to the end of his life.

This *culte* for David (for it was nothing else) was, in a manner, the bane of Gros's life. Timid, depreciating his own powers, and unable to trust his own tastes, he leaned too much upon his master during the early and the later years of his career, and it was only the accident of meeting Napoléon, and being influenced by his strength of will, that made Gros follow his own instincts. He had no Classical tastes, he cared nothing for the doings of the Greeks and Romans, but the fashion of the day was for this kind of art, and so he followed in the stream. But the Revolution came upon him like a thunderclap. Naturally nervous, losing his father and his fortune, the terrors of the guillotine made him utterly unable to continue his lessons and other work, and so he induced David to get him a passport. This the elder man easily did by telling the section of the Tuileries that his pupil wanted to perfect his studies in Rome, and so, in January, 1793, Gros quitted his mother and his native city. Before this he had had a hard time of it in painting portraits (amongst others, some of the members of the Convention) at 6 francs a head!

Meeting Joséphine at Genoa, they became acquainted, and, upon Gros showing her some of his portraits, Madame Bonaparte, as he calls her, was so struck by his talent (or himself, for he was very handsome) that she persuaded him to accompany her to Milan to be introduced to the General. Napoléon greeted the young man with affability and agreed to sit for his portrait, and, also, upon the suggestion of Joséphine, attached him to the Commission for despoiling Italy of her works of art. But his dreams of painting the heroic were not yet carried out. Fettered by poverty, and after some time deserted by most of his friends, who had returned to France, he determined to leave Italy and rejoin his mother.

Once more in Paris, Gros was filled with enthusiasm for the exciting scenes of Napoléon's battles. His mind was full of war and heroic deeds, and so, when a competition was opened amongst twenty artists for a "Battle of Nazareth," he naturally put out all his strength. He obtained the commission, but after being installed in the Salle du Jeu-de-paume at Versailles, and after making divers sketches, the work was stopped by the First Consul, who, it was thought, could not permit his rival, Junot, to be immortalized. This may be so; Napoléon was mean and envious and jealous, but surely not to this extent, though, perhaps, at this early stage of his career, he may not have felt strong enough to be magnanimous. At any rate, he was generous to the artist, if not to the commander, and, to compensate Gros for the loss, he ordered him to paint his visit to the plague-stricken in the hospital of Jaffa. This picture, now in the Louvre, illustrates the heroism of Bonaparte in a new light. All the world had heard of his prowess, let them also see that he feared the contagion of fever no more than death on the battlefield! But if Napoléon intended the work to consolidate his reputation, it was certainly the means of laying the foundation of the painter's.

Gros' next work was the "Battle of Aboukir," a picture full of movement, which quality, added to a perfect knowledge of the horse in action, was this artist's special *forte*. But the "Battle of Eylau," now in the Louvre opposite the "Pestiférés de Jaffa," is his greatest work. Full of dramatic power and rich in color, it conveys to the

[1] "*Les artistes célèbres: Le Baron Gros*," par G. Dargenty. Paris, Rouam.

spectator's mind the horror and brutality of war; one feels that the conqueror (arrayed like a fop in a gray satin coat trimmed with fur), may, for once in his life, have sincerely felt the truth of his own words the morning after the battle: "*Ah! si les rois pouvaient contempler ce spectacle, ils seraient moins avides de conquêtes.*" But even the misery of Eylau, the blood trailing over the snow, the wounded men frozen to death, the horrors which even make one shudder when gazing at Gros' picture, were not sufficient to stay the ambition and lust for blood in this barbarian, though seen in the increased horror of reality.

Gros was the first unfortunate painter to undertake the decoration of the Panthéon. Napoléon desired to be one with the other sovereigns of France, and so we have a design for the biggest dome of Paris, which groups him with Clovis, Charlemagne, and St. Louis! The best part of the work is the central group of winged spirits; but the arrogance of Bonaparte knew no bounds. Whereas St. Louis, his wife, Charlemagne, Clovis, Clotilde, and even Marie Thérèse are all kneeling, he and his son stand and sit! The history of this picture is curious. Begun in 1812, Gros was to finish it in eighteen months, and to receive 36,000 francs in payment. But 1814 arrived, and found it unfinished; and so Louis XVIII and the duchesse d'Angoulême were substituted for Napoléon and Marie Thérèse, Gros receiving an extra 15,000 for his trouble! In 1815, the Emperor returned in the flesh, and naturally Gros was ordered to replace his spirit upon the cupola of the Panthéon. Again Louis XVIII disappeared; but alas! so did Napoléon after Waterloo, and the King once more eclipsed the emperor. Louis Napoléon left him in his glory, and the Republic hitherto has not thought it necessary to make any change in the heights of the building, preferring to decorate their great men's temple with scenes from the lives of the saints. Perhaps we may yet see these replaced by less legendary beings with subjects taken from the lives of the "Grands Hommes" to whom the country is so grateful! We devoutly hope not; the Panthéon has suffered enough already from the follies of party politics and men's evil passions, and deserves to be left in peace for the future.

With the downfall of the Empire, came the decadence of Gros as a painter. Louis XVIII tried to patronize him; but the world was sick of bloodshed and heroism of the modern type, and Gros fell again under the influence of David's classic tastes. There is something very touching in the adoration of Gros for his old master, and we find him endeavoring to carry out David's wishes to devote himself to "*la grande peinture.*" David was in exile in Brussels, and so much correspondence upon the subject took place between them. The master thoroughly believed in the pupil's talent, and the pupil had perfect faith in the master's wisdom. But they both erred. David's notion of grand painting was, that no subject was worth treating out of Classic history. He talks of Gros undertaking a great historical picture; but he tells him to study his Plutarch, his Œschylus, Sophocles, Euripides, and his Bible! Nothing more modern was grand. Nothing which stirred the hearts of living men and women was heroic. The struggles of the Republic for freedom, and the battles of the Empire were mere child's play compared with similar events in ancient history. And so we find the docile pupil erring as did his master; for both painters are now valued for their modern work — David for his portraits, and Gros for "Eylau" and "Jaffa." Who can now bear the staginess of the classicisms of either painter? And thus the end of Gros' career was wrecked. There was a slight episode in his downward career which gave him some comfort, the enthusiasm of Delacroix (then a young man) for his battle pictures; and much of the latter's work was modelled on that of Gros; indeed there is no doubt that Gros influenced all the younger realistic school besides Delacroix and Géricault. Whether M. Dagenty is right in placing Gros higher than Géricault, we are in no wise sure; we may be wrong, but to us the latter's "Naufrage de la Méduse," is the grandest picture of the French school of that period. We also prefer Géricault's portraits to Gros'; but all these three men deserve the thanks of the present generation, in breaking through tradition, and making painting the interpreter of men's minds and hearts.

Had Gros possessed more self-will, had he had more confidence in himself and his own instincts, he never would have incurred the ill-nature of his critics. As it happened, the devotion of his wife and his numerous pupils were not enough to keep him from suicide. Bonaparte was exiled, David had died in exile, consequently he had no one to lean on. In spite of the sympathy of his friends, he could not get over the criticism of his enemies; as he pathetically remarked: "*Puisque je ne suis plus bon à rien je n'ai plus qu' à me jeter à l'eau;*" and so one morning he drowned himself at Meudon, near Sévres, the victim of the critics. Posterity has given him an honorable place, as the founder of a new school, which includes amongst his immediate pupils, Delacroix, Bonnington, Breton, Couture, Lami, Moreau, Rousseau and Leprince; and in this generation, a whole army of modern realists.

FIRE RECORD FOR AUGUST.—The *Daily Commercial Bulletin's* fire record for August shows a total loss in the United States and Canada of $8,317,500, against $13,000,000 in August, 1886. The average August losses for ten years have been about $7,000,000. The total losses for the first eight months of 1887 are $85,245,600, against $76,900,000 for the corresponding period of 1886.

COMMUNICATIONS.

ANOTHER ARCHITECT'S TROUBLES.

September 2, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — Will you kindly give us your opinion on the case stated below:

A asks B, an architect, to draw him plans of a frame house to cost $3,000. B prepares preliminary sketches and submits them. These are altered by A's desire, and three different sets of plans submitted. In all these a house can be put up in a plain style for the $3,000. Finally, plans are adopted, and expensive interior fittings ordered to be specified for, such as mullion windows in four rooms, seven windows to open to floor, three windows entirely of stained glass and five border lights, front door half-stained glass, Conway's champion sliding blinds for main windows, two double and four single Davis-patent hanging and sliding doors, red-wood mantels, electric bells, speaking-tubes, bath-room fitted with patent closet, etc. A picturesque roof with three gables, fancy shingles, also insisted upon by A's better half, who had formed her ideas from Shoppell's house plans, and thought she could command these conveniences for a moderate sum. The height of the stories was 12′ 6″ and 12′ 0″ respectively, more air being required here than in a northern climate. B warned A that these additions and fittings would run up the amount to far above the sum originally named. A nevertheless instructed B to draw up the plans and specifications to the full extent of these additions, etc., and that, should the builders estimate be higher than $3,000, certain parts of the house shall not be built, but struck out of the plans, so as to lower the cost to the desired sum. The plans and specifications were finished and delivered to A on August 8. Hearing nothing from A on the subject, on August 31, B sent in his bill for two and one-half per cent on the estimated cost of the house, $3,000 — no superintendence. On September 1, B received a curt note from A that he returns herewith the plans and specifications, as they are of no use to him, as the house cannot be put up for the money, *i. e.*, $3,000.

Is B to be summarily dismissed in this manner and deprived of payment of his work, or has he a case for a suit at law to recover charges for the plans, etc.? JUSTICIA.

September 9, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — We forwarded you a case for your opinion on September 2. Since that date an important fact has been discovered. A returned, with a letter, "the plans and specifications" referred to in the case submitted. On B examining the parcel he found a copy of specifications printed with a type-writer, giving A's name as the person for whom the house was to be built, also B's name as architect. This type-writer copy was, however, not a correct copy of the original given A by B, but contained many important additions and alterations, such as fencing, back-closet, boiler, hanging-doors, alterations of sizes of windows, reeding, etc., thus adding several hundred dollars to the cost of the building. These specifications are signed by A. B knew nothing, was not notified of these additions, etc., but A gave the specifications so amended by him to two builders for estimates. This conduct appears to B to be, if not criminal, something very near it. It will damage his reputation as an architect beginning business, the specifications so altered being false, and not the ones prepared by the architect. The original has not been returned.

We do not desire our names to appear in print, but wish the case to be from "JUSTICIA."

[WE should hesitate to say that A had deliberately falsified B's specification for the purpose of defrauding him. The case looks like one of those very common ones where an arrogant, overbearing client thinks he can bully a young architect into getting him bath-rooms and other extras for nothing, and, if he is disappointed, can do as he likes about paying the architect's bill. If B, as he says, having the limit of cost given him, made plans of a house containing substantially the accommodation required, which could be erected in a good and workmanlike style for a price within the limit; and if he then, when A proposed changes and additions, warned him that these would add materially to the expense, he has done all that is required of his professional skill, and would, we think, have no difficulty in collecting at law the usual fee for the drawings and specifications of the original house, besides a fair compensation for the extra work involved in studying and arranging for the additions which he was directed to make, and in modifying the drawings and specifications accordingly. — EDS. AMERICAN ARCHITECT.]

HOW TO BUILD AN ICE-HOUSE.

September 6, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — It is desired to build an ice-house to hold 1728 cubic feet of ice. We want battering cobblestone walls with conical roof.

1. Should floor (of concrete) be above level of ground?

2. Should walls be solid or hollow? If the latter, would a four-inch inner brick wall bonded with outer wall by frequent hoop-irons across a three-inch air space suffice?

3. Should roof be of solid plank, or with rafters and air-spaces?
4. What is better for roofing, shingles or slate?
5. Is ventilation desirable?

Respectfully yours, JUDAH.

[1. The ice-house floor should be above the level of the ground, or, at least, should be sufficiently above some neighboring area to give an outfall for a drain, put in in such a way as to keep the floor clear of standing water.

2. The walls should be hollow. A four-inch lining-wall, tied to the outer wall with hoop-iron, and with a three-inch air-space, would answer, but it would be better, if the air-space is thoroughly drained, to fill it with mineral-wool, or some similar substance, to prevent the movement of the air entangled in the fibres, and thus check the transferrence by convection of heat from the outside to the lining-wall.

3. A roof of thick plank will keep out heat far better than one of thin boards with an air space under it.

4. Shingles will be much better for roofing than slate.

5. It is best to ventilate the upper portion of the building. If no ventilation is provided, the confined air under the roof becomes intensely heated in summer, and outlets should be provided at the highest part, with inlets at convenient points, to keep the temperature of the air over the ice at least down to that of the exterior atmosphere. — Eds. American Architect.]

CORRECTIONS.

To the Editors of the American Architect: —

Dear Sirs, — Your reviewer of the life of La Tour has fallen into a curious error in saying that he was "drawn into *companionship* with such artists as Van Dyck, Watteau and Desportes, all of whom influenced him very much in after life." Van Dyck died in 1641 — *sixty-three years before La Tour was born.* Watteau died in 1721, and was ill some time before his death, which occurred when La Tour was only seventeen years of age, so that their "companionship" must have been of a very limited kind.

Yours faithfully, PENGUIN.

Providence, R. I., September 19, 1887.

To the Editors of the American Architect: —

Dear Sirs, — Will you please make correction in the next issue of the *Architect* in regard to the location of the Barrington Town-hall? Please note that the drawing says "Barrington, R. I.," while the text says "Great Barrington, Mass."

Yours truly, Stone, Carpenter & Willson.

NOTES AND CLIPPINGS

Wages in 1800. — The condition of the wage class of that day may be well examined; it is full of instruction for social agitators. In the great cities unskilled workmen were hired by the day, bought their own food, and found their own lodgings. But in the country, on the farms, or wherever a hand was employed on some public work, they were fed and lodged by the employer and given a few dollars a month. On the Pennsylvania canals the diggers ate the coarsest diet, were housed in the rudest sheds, and paid $6 a month from May to November, and $5 a month from November to May. Hod-carriers and mortar-mixers, diggers and choppers, who, from 1793 to 1800, labored on the public buildings and cut the streets and avenues of Washington city received $70 a year, or, if they wished, $60 for all the work they could perform from March 1 to December 20. The hours of work were invariably from sunrise to sunset. Wages at Albany and New York were three shillings, or as money then went, forty cents a day; at Lancaster, $8 to $10 a month; elsewhere in Pennsylvania workmen were content with $6 in summer and $5 in winter. At Baltimore men were glad to be hired at eighteen pence a day. None by the month asked more than $6. At Fredericksburg the price of labor was from $5 to $7. In Virginia white men employed by the year were given £16 currency; slaves, when hired, were clothed and their masters paid £1 a month. A pound Virginia money was, in federal money, $3.33. The average rate of wages the land over was, therefore, $65 a year, with food, and perhaps lodging. Out of this small sum the workman must, with his wife's help, maintain his family. — *McMasters's History of the United States.*

The most Elevated Church in Europe. — "The very highest church in Europe," according to the *Bundner Tagblatt*, "is the pilgrimage chapel of St. Maria de Ziteit, above Salux, in the canton of Graubünden. It lies 2,434 meters above the sea level — nearly 8,000 feet high, above the forest, near the limits of perpetual snow. It is only open during the summer-time of that region — or, as the folks thereabout reckon, from St. John the Baptist's Day to St Michael's Day — and is used only by the Alp herds, who remain there through the summer with their cows and goats, and occasionally by hunters in search of the chamois and marmot. All the inhabitants of Salux climb up thither on midsummer day to assist at the first mass and hear the first sermon of the year, and there is also a crowded congregation on Michaelmas Day, at the last service of the year. From time to time a few stray pilgrims from the Graübunden Oberland and the Tyrol find their way here. The second highest church probably in Europe, that of Monstein, also open only in the summer, belongs to Graubünden. At our visit the hale old preacher had five foreign tourists for his congregation."

Charleston since the Earthquake. — During the year since the earthquake in Charleston, between 5000 and 6000 buildings, exclusive of churches and public buildings, have been overhauled and restored, and in some cases put in better condition than before. In addition to these, 141 buildings have been remodelled or rebuilt merely for improvement's sake. New buildings to the number of 271 have also been erected, to meet the growing demand for residences and places of business. Not less than $3,500,000 has been expended in the work of restoration and improvement. — *Boston Journal.*

TRADE SURVEYS

Notwithstanding the volume of currency has been doubled within ten years there are numerous symptoms of an approaching scarcity. Since that time railroad mileage has been nearly doubled, and manufacturing capacity has increased fully as much. A thousand towns and cities have sprung up, most of them in the West and South, creating demands and markets. The population has scattered into the newly-developed regions, and have thus greatly increased agricultural productions and have opened up new markets for manufactures, fuel, lumber, clothing, etc. Land values have expanded enormously, and necessities have arisen all over the country for more money. The elasticity of our financial system does not seem equal to the rapidly-expanding requirements of business, at least if the views which seem to be seriously entertained by numerous reputable financiers and financial writers are to be accepted at par value. There does seem to be good reason for apprehending a financial stringency sooner or later which will bring more than usually serious consequences. The banks are loaned up. Individual lenders are pretty well exhausted. It is argued and believed that the requirements for money will continue to grow as rapidly in the future as in the past, and if so it is said that a stringency is inevitable. Among the methods suggested to alleviate the attendant ills is the loaning of the Government cash at two per cent on bonds deposited as security; a sort of resurrection of the discarded greenback doctrine. The two causes of existing conditions from a financial standpoint are the appreciation of values and the greater needs of the country. Both causes may, but one is certain to continue to act. A general decline in values is not impossible. Several recent symptoms have manifested themselves, but with labor where it is, no material decline is possible, and nothing but a national depression which would disorganize and idle a large part of our laborers would reduce the cost of labor. The pressure for money will increase as soon as circumstances clearly demonstrate that the volume is insufficient. Trifles have done this in our past history and may do so again. One of the first results of such stringency would be the abandonment or curtailment of future enterprises. An immense amount of capital is to be invested next year and year after in enterprises, many of which will not be productive for two or three years after. Wild guesses have been made recently as to the volume of invested capital not yet productive, and it is put at one thousand millions as a sort of swinging point. Shrewd financial managers recognize the time is near at hand when it will be wiser to have ready cash in vaults to seize titles of sinking tradesmen, stock-holders, bond-holders, and investors, than to have it slowly earning its two to six per cent dividends. And if reports are true, upwards of fifty million dollars have been already locked up in view of a stringency, which policy aggrevates the anticipated disease. The great body of the people, who make and exchange values have, for ten or more years, neither had the occasion nor the time to study matters like these, but it looks as though circumstances were conspiring to draw them to the consideration of the problem. The banks cannot much longer meet the increasing demands without calling in loans which it would be impolitic for them to do. The Government can lend very little additional assistance without the inauguration of a policy which requires the nerve and intelligence of a bold, well-balanced head. There is a remedy, but there must be a strong public sentiment to secure its application, viz., the hypothecation of bonds with the Government for cash, yet, as heretofore said, the alarms raised as to immediate dangers are unnecessary. The power of adaptation to circumstances is characteristic of the American people. A stringency of money for a week or month does not necessarily involve disaster, but it does involve a restriction of work. Even a general curtailment of activity is not the worst evil that might befal this nation. We have six days for work and one for rest in the Christian week, but in the commercial and industrial weeks, as measured by years, we have no Sunday. The tendency to artificial values sometimes needs checking. The advancing rates of money, if maintained, will plant a plentiful crop of evil. Our decade of prosperity has been largely due to low rates of interest and reasonable cost of labor These strong props have been weakened within the past two years, but stimulated enterprise fails to take note of it. Perhaps then the critic says a stringency is desirable. Not in the least, because other remedies are at hand than those which are born in the throes of bankruptcy, limited or widespread. The much-talked-of dangers from financial stringency are, however, overdrawn. If it comes good will follow; if it is avoided, as it can and will be, greater national strength and endurance will be gained. The industries show no sign of the storms in the clouds. The distribution of merchandise was never greater. Railroad companies cannot furnish sufficient rolling stock, and the car-builders are working by electric lights. A few railroad companies who mapped out extraordinary work for next year have voted delay on some of their projects, but there are scores of other and anxious railroad projects awaiting the helping hand of the domestic or foreign capitalists. In British and European manufacturing channels there is less depression and better prospects, though the conditions there forbid robust industrial health; hence there is a constant outflow of skilled and unskilled labor to the States which promises to prevent a rise in the cost of labor, no matter to what extent labor may be organized. The trades-union movement is increasing among the laboring classes, and the spirit of organization is still thoroughly awake, though the leadership has enforced more conservative views. The anthracite miners have this week secured the first victory they ever secured in inducing the leading companies and individual operators to arbitrate and advance wages eight per cent, besides agreeing to a sliding scale. The coke-workers are still toying with the scale, and a general strike is desired by the leaders who felt themselves out-generaled last spring. The iron and steel workers are quiet, and mills and furnaces were never turning out a greater product. The lumber manufacturers have a market for all the products of their mills and are not jeopardised with unmanagable stocks. The shop and factory capacity of all kinds East and West is crowded, but competition is taking the poetry out of business in some directions. Trade combinations multiply, but consumers' interests are not threatened. There is a strong outside contingent in every trade and industry of independent producers who cannot be controlled, and who serve to check radical action among the organized interests. Farmers, planters, manufacturers and miners are all doing well. Railroad interests, store-keepers and jobbers are all as busy as their energies allow. Collections are good. Losses are few. Stocks are light, and the future prospects are such as to keep a broad grin of satisfaction on the countenance of Uncle Sam.